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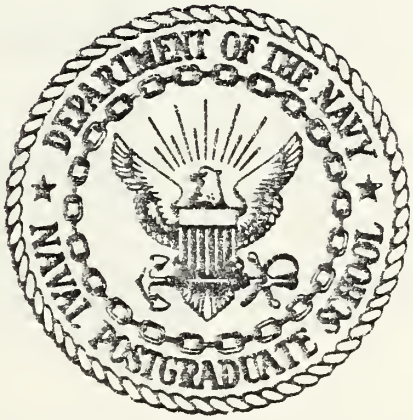

THESIS

Cost-Performance Relationships for use with the Uniform Chart of Accounts for Military Medical Treatment Facilities

by

Steven Duane Olson

March 1979

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In response to comments and criticisms of the military health care study, the Department of Defense developed a Uniform Chart of Accounts for Military Medical Treatment Facilities. On 1 October 1977, the uniform chart of accounts was implemented at ten test sites representative of activities of the three services. Two benefits envisioned from this reporting system were improved capability to make comparisons between the military services and

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the capability to make comparisons with the civilian sector. While specific criteria and procedures to be followed in collecting and reporting the cost data are specified, the uniform chart of accounts does not provide guidance as to the manner in which the data will be or should be utilized or how the comparisons will be made.

This study was an attempt to identify those attributes characteristic of a suitable measure, suggest cost-performance relationships which are capable of being supported by the uniform chart of accounts, and test these relationships with data from the ten military sites selected to test the chart of accounts. Based upon the analysis, a recommendation as to the suitability of the relationships as a basis for comparisons was made. Finally, recommendations which may improve the utility of the uniform chart of accounts were also offered.

Cost-Performance Relationships for Use with the Uniform Chart of Accounts for Military Medical Treatment Facilities

by

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ABSTRACT

In response to comments and criticisms of the military health care study, the Department of Defense developed a Uniform Chart of Accounts for Military Medical Treatment Facilities. On 1 October 1977, the uniform chart of accounts was implemented at ten test sites representative of activities of the three services. Two benefits envisioned from this reporting system were improved capability to make comparisons between the military services and the capability to make comparisons with the civilian sector. While specific criteria and procedures to be followed in collecting and reporting the cost data are specified, the uniform chart of accounts does not provide guidance as to the manner in which the data will or should be utilized or how the comparisons will be made.

This study was an attempt to identify those attributes characteristic of a suitable performance measure, suggest cost-performance relationships which are capable of being supported by the uniform chart of accounts, and test these relationships with data from the ten military sites selected to test the chart of accounts. Based upon the analysis, a recommendation as to the suitability of the relationships as a basis for comparisons was made. Finally, recommendations which may improve the utility of the uniform chart of accounts were also offered.

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I. INTRODUCTION

Since 1974, the end of the Economic Stabilization Program, increases in national expenditures for health care in the United States have continued to surpass the rate of increases in Gross National Product (GNP). In fiscal year 1975 the nation spent over $118 billion for health care or approximately $547 for each man, woman and child [1]. In 1976 national expenditures had increased to $139.3 billion for health care, an average of $638 per person [2]. In both years, the increases in health care expenditures represented a 14% increase from the previous year and consumed in excess of 8% of the nation's Gross National Product [2].

The Department of Defense did not escape increasing health care costs. The effect of health care cost escalations was particularly noteable in view of reductions in the defense budget after the Vietnam era while weapons systems and personnal costs increased significantly. As the portion of defense budget available for health care decreased the medical departments of the three services were subjected to increased scrutiny both from the Department of Defense and from Congress. Efforts to allocate an equitable share of the available funds to each service medical department were often frustrated by the inability to make efficiency comparisons between the medical programs of the three services. The frustration increased as the medical departments submitted different size budgets for

similar programs. Members of Congress as well as the Department of Defense were becoming increasingly skeptical of "we're different" and "we don't account for costs that way" explanations for cost differences between the services.

In December 1975, the Report of the Military Health Care Study was released [3]. The Military Health Care Study (MHCS) was a joint project of the Department of Defense, the Department of Health, Education and Welfare, and the Office of Management and Budget commissioned in August 1973 at the direction of the President. While the study recognized the services as providing relatively effective and efficient health care, it confirmed deficiencies in the military health care system which many had thought to exist.

One particular area of the study criticized the services for a lack of adequate population, workload and cost data, and comparable information systems [3]. With respect to programming and cost accounting, the MHCS cited six categories of cost data in which inconsistencies between the three services were significant enough to make comparisons between the medical departments inappropriate [3]. In order to resolve these specific deficiencies, the study recommended that costs per beneficiary be developed and used as a measure of efficiency and performance. Development of such a cost measure would require the design and implementation of two information systems. The first information system would provide information on the beneficiary population and demographic characteristics

and the second would provide uniformly developed information on the cost of providing various health care services at military facilities.

In response to the comments and recommendations of the Military Health Care Study, a tri-service working group was formed in July 1976 and tasked with developing a uniform cost reporting system [4]. The specific objectives of the working group were as follows:

1. Develop a single uniform chart of accounts for the three services which encompassed common definitions for performance, cost elements and manpower utilization. The chart of accounts was to facilitate comparisons both between the military departments and with the civilian community including Champus.

2. Develop a methodology for uniformly distributing or allocating overhead, base operations support, ancillary support and similar costs which are not directly expensed to patient care functions.

3. Develop a uniform information structure which will respond to management needs for information and the Military Health Care Study recommendations.

4. Produce a document which has been coordinated with each of the military departments.

In slightly over one year, a preliminary draft entitled Uniform Chart of Accounts for Military Medical Treatment Facilities had been completed by the working group. The test draft

of the uniform chart of accounts was implemented on an experimental basis at ten sites composed of Air Force, Army and Navy activities on 1 October 1978. This draft, with anticipated improvements and modifications, is scheduled for world-wide implementation at DOD fixed medical and dental treatment facilities on 1 October 1980.

In consonance with the objectives of the working group and the recommendations of the Military Health Care Study, the stated purpose of the uniform chart of accounts is "...to provide a common standard of measurement and communication, both inter- and intra-service, through the use of uniform work performance indicators, common classification of expenses by work center, statistical definitions and cost assignment methodology" [4]. In addition, the uniform chart of accounts was viewed as a necessary prerequisite to the establishment of a uniform reporting system [4]. The principle benefits envisioned from this reporting system were that comparisons among and between similar Army, Navy and Air Force medical treatment facilities would become possible. In addition, comparisons with the civilian sector would be more easily accomodated [4].

The uniform chart of accounts was originally conceived as a Department of Defense reporting tool. It was later intended that managers at the service and activity levels should also benefit from this uniform reporting system. Reference 4 lists the benefits expected to accrue to the activity which include the following:

1. Creation of cost awareness.

2. More accurate and complete expense information.

3. Assignation of expenses to the work center responsible for the expense.

4. Categorization of management cost effectiveness.

5. Facilitation of decision-making in situations where cost is a significant factor.

6. More meaningful work-count.

In developing the uniform chart of accounts, the principle concern of the designers was insuring that cost and workload data would be collected, allocated and reported in a uniform manner by all three services.[1] This concern may have been predominant because of the recommendation of the Military Health Care Study, as well as pressure from Congress and the Department of Defense to have a system which would facilitate comparisons between the three services. As a consequence, the uniform chart of accounts contains specific criteria and procedures to be followed in collecting and reporting the cost data. In contrast, the uniform chart of accounts does not provide guidance as to the manner in which data will be utilized. While one of the primary purposes of the uniform chart of accounts is to enable comparisons with the civilian community, the uniform chart of

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[1]Conversations with the project officers representing the three services during development of the Uniform Chart of Accounts for Military Medical Treatment Facilities.

accounts does not address the type of comparisons which should be made nor does it establish procedures for analyzing the data generated by the UCA.

While the concern over developing a system which reports cost data uniformly among the services is understandable, the absence of specific applications for the data generated by the UCA makes difficult the task of evaluating the ability of the UCA to facilitate comparisons, particularly with the civilian community. The manner of comparison intended by the originators could not be determined during this research, partly because the system has progressed to a point that it dictates the type of comparisons which are possible. While there are broad statements as to the type of comparisons which are desirable, the concepts are not presently linked to the design of a system which will provide the specific data necessary to facilitate such comparisons. Until a determination is made as to the specific comparisons which are desired, a reporting system cannot be evaluated with respect to its suitability for providing the necessary data, nor can procedures be developed for manipulating the data to accomplish the comparisons.

At present, the uniform chart of accounts is generating data from ten military test sites representing each of the three services. In the absence of formulated criteria on which to make comparisons, procedures have not been developed for analyzing the UCA data.

The objective of this thesis is to analyze the Military Health Care Study and uniform chart of accounts test draft for

an underlying suggestive methodology on which to structure comparisons and evaluate the ability to make meaningful comparisons between the services and with the civilian community. Where appropriate, recommendations will be made which may enhance the ability of the UCA to facilitate comparisons.

The attributes which are desirable of a good performance relationship measure will be discussed in Chapter II. Four cost performance relationship categories which offer potential as bases on which to construct comparisons between activities will be presented. The relative merits of each measure as well as its weaknesses will also be discussed.

In Chapter III, the analysis methodology will be discussed. The origin of the data, its limitations and noteworthy problems will be presented. The method used for the comparative analyses will be described. Finally, the results of the many analyses will be presented.

The reader is invited to review Appendix A for a brief summary of the organization of the Uniform Chart of Accounts for Military Medical Treatment Facilities. Appendix B discusses in greater depth the research process including the service perspective, the literature review and the statistical design found appropriate for the analyses. Appendix C seeks to put the uniform chart of accounts of DOD in perspective in relation to the military financial accounting system.

II. COST/PERFORMANCE RELATIONSHIPS

In order to make meaningful comparisons between organizations or evaluate their performance over time, it is necessary to establish a common measure and a point of reference. For example, it is not meaningful simply to compare operating costs of activity A of $12,000 with the operating costs of activity B of $120,000 even if the two activities are involved in the same type of business. Either additional information is necessary or a means of translating the information into a meaningful form must be found. The usual means of placing the activity's costs in comparable form is to make comparisons in terms of output produced. In profit-oriented organizations output is relatively easy to measure. In non-profit organizations, however, output measure is more difficult. To make matters worse, in the health care field even defining the output has been difficult [5]. Output information is useful for evaluating the "efficiency" (the input required to produce a unit of output) and "effectiveness" (the extent to which actual output corresponds with the organization's goals) of the organization [6]. In view of the difficulty in defining output, surrogate or proxy measures must be created as a means of facilitating comparisons.

While performance measures were included in the uniform chart of accounts, specific methodologies for making comparisons between activities, the three services, or with the civilian

community were not established. Therefore, an initial objective of this thesis was to determine the types of analyses which are presently conducted by the health care community with respect to medical facilities. Telephone interviews were conducted with the representatives of the California Health Facilities Commission, the Washington State Hospital Commission and the Department of Health, Education and Welfare to determine the type of analysis anticipated by organizations responsible for monitoring a uniform chart of accounts. In addition, a search of the literature was conducted to identify the foundation of current methodologies used in analyzing health care information. No attempt was made to determine the appropriateness of the various types of analyses. This was beyond the scope of the research work.

A second objective was to identify the data requirements of the various methodologies to determine if the uniform chart of accounts could support such analyses. A multitude of methodologies exist in the literature and it is clear that the UCA will not be able to support them all. Identifying those methodologies which are capable of being supported by the uniform chart of accounts is therefore an appropriate means of reducing the comparisons to a manageable level. In actuality, this process virtually eliminated all sophisticated methodologies from consideration as well as the simpler methodologies which showed promise. The uniform chart of accounts simply does not provide all the data necessary to support the methodologies

which are currently in use at various sites. In view of the limitations of the UCA to provide the data necessary to make comparisons with the civilian community, this aspect of the thesis was foregone. A more detailed discussion of the research process is contained in Appendix B.

A. MEASURE ATTRIBUTES

It therefore became the objective to construct a specific methodology which utilizes the UCA-generated data. In the process of identifying suitable cost/performance relationships, several considerations are necessary.

First, if at all possible, the cost/performance relationships should facilitate those comparisons suggested or inferred by the Military Health Care Study [3]. It is obvious from the recommendations contained in the Military Health Care Study that the authors had a strong preference for population-based planning and analysis [3]. The seventh recommendation of the study states: "Costs per beneficiary should be developed and used as a measure of efficiency and performance " [3]. It therefore seems appropriate to develop cost/population relationships which will serve as a means to make comparisons.

Second, it appears desirable to make the maximum use of the performance measures included in the uniform chart of accounts. Although it is not stated in the UCA, the fact that performance measures are included suggests that it is reasonable and appropriate to utilize the measures as a basis for making comparisons. Maximum use of these measures in various analyses

will serve to provide an indication of their suitability as well as their limitations.

Third, if a methodology is to be suggested, it must not create perverse incentives for the organization. The measure should not encourage the organization to do the "wrong thing." For instance, Phase II of the Economic Stabilization Program had the undesirable effect of creating strong incentives for volume expansion and imposed severe financial penalties for volume contraction [7]. In contrast, the type of analysis for the UCA should motivate the type of behavior really desired.

Fourth, the variables on which an analysis is based should not be manipulated by the activity. If the possibility exists for manipulation, some counter analysis should be available which will discourage undesirable activity. For instance, if cost per occupied bed day is used as the basis for comparison, an activity could appear in a more favorable light by increasing the number of admissions or increasing the length of stay. Neither action may be efficient or effective. Therefore, some analysis should be possible to discover this undesirable behavior. A reduction in the cost per occupied bed day should be the result of improved performance, not manipulation of the elements which comprise occupied bed days while there is an increase in total costs, for instance.

Fifth, the data required by the analyses must be capable of being supplied by the uniform chart of accounts since one of the purposes of this thesis is to determine the capability

of the uniform chart of accounts to provide information which will facilitate comparative analysis. Therefore, it was determined that analyses should be restricted to the data provided by the UCA. An exception was made with respect to beneficiary population data since this figure is necessary to conduct the analysis suggested by the Military Health Care Study and should exist independently of the UCA.

Finally, it is desirable to have a measure which will also facilitate comparisons at an aggregated level to the extent possible. A cost/performance relationship for aggregated data would be valuable as a screening mechanism to identify those activities which should receive initial attention. The limitations of aggregate measures must be recognized, however. In their discussion of marginal cost estimates in hospital cost containment, Lipscomb, Raskin and Eichenholz [7] point out that a hospital is a multiproduct firm and case-mix proportions are likely to vary among hospitals. Therefore, the use of a single variable to represent output will imply a product homogeneity which does not exist. While this deficiency may possibly render aggregate comparisons unsuitable for direct policy purposes, it may still be appropriate to use aggregate comparisons as a screening mechanism.

With the above considerations in mind, several cost/performance relationships have been developed which appear to be suitable bases for facility comparisons. The relationships may be categorized as (1) cost/population relationships, (2)

cost/output relationships, (3) cost/equivalent occupied bed day relationships, and (4) cost/percentage relationships. Each of these four categories will be described and the apparent deficiencies of the measures discussed.

B. COST/BENEFICIARY POPULATION RELATIONSHIPS

Relationships which include beneficiary population as an element of its composition have been viewed as a means of placing activities on an equivalent and objective footing for comparative purposes. Cost per beneficiary measures do contain several advantages which make them desirable as a standard for comparison.

First, beneficiary population is a unit of measure which appears to be suitable for use throughout the activity. In contrast, output measures such as occupied bed days, visits and hours of service, to name a few, are limited to a few services, generally of the same type. As a consequence, meaningful comparisons which cannot be made between services with different output measures, can probably more easily be made using beneficiary population as a factor.

Second, beneficiary population is a factor which is essentially beyond the control of an activity. This suggests that in order for an activity to show improvement in a beneficiary population-based measure, the activity must become more efficient or effective. Since the measure is not manipulable by the activity, there is less need for counter measures aimed at discouraging or detecting undesirable behavior.

Finally, beneficiary population-based measures tend not to contain incentives which motivate undesirable behavior. As noted above, there is little an activity can do to appear in a more favorable light except become more efficient. While increasing the number of visits will lend an appearance of improvement with an output measure, such action would cause the activity to experience increased costs and appear even more unfavorable under a beneficiary population measure.

Despite the favorable advantages of measures which include beneficiary population as an element, there are limitations in the measure. Many factors interact which influence the demand for care which are not explained strictly by population numbers. Cultural and demographic factors, geographic factors (this has a particular effect on comparisons between military facilities), mission differences, size, number of services provided, and many other factors all impact upon the activity and influence its costs. It therefore appears likely that pure beneficiary population measures may not prove to be entirely satisfactory. Rather, it appears necessary for the beneficiary population to be adjusted for the cultural, demographic, geographic and other factors exogenous to the organization. Thus, a more appropriate measure may be one which utilizes an "adjusted" beneficiary population.

Due to the complex nature of the above factors, it was not possible to construct an adjustment measure for each activity. Therefore, the analyses completed during this thesis, which

utilized a beneficiary population measure, relied upon an unadjusted measure.

C. COST/OUTPUT RELATIONSHIPS

As previously indicated, the output produced by health care organizations has been difficult to define. As a result, surrogate measures have been developed as a means of enabling comparisons to be made. The uniform chart of accounts specifies a performance factor for each account. All inpatient accounts use "occupied bed days" (OBD) as the performance factor while all ambulatory care accounts use "visits" as the measure of performance. The performance factors for the ancillary services accounts include "weighted procedures", "hours of service", "visits" and others. The support service accounts contain performance factors such as "full-time equivalent man-months", "hours of service", "pounds of laundry processed" and others, although some accounts don't contain a performance factor. Most of the special program accounts do not contain a performance factor.

The inclusion of performance measures in the uniform chart of accounts suggests that it was intended that they serve as surrogate measures of output. When using these performance measures for comparative purposes, the limitations of the particular measure must be recognized. While all the measures mentioned above contain deficiencies of one degree or another, attention will be focused on the measures for the inpatient

care, the ambulatory care and, to some degree, the ancillary care accounts.

1. Occupied Bed Days

This performance measure is applicable to all inpatient care accounts and it provides a measure of the number of patients admitted to the activity as of the census taking hour [4]. OBDs (synonymous with patient days) as an output measure has been criticized for several reasons.

First, OBDs are viewed as only an approximation of output since the quantities and mixes of services rendered are not uniform between hospitals or even over time [8]. Hospitals differ in size, number and type of services provided, length of stay and other factors which make comparisons between hospitals difficult. Different capital and labor intensities are required for different services. A single occupied bed day indicator does not account for these differences.

Second, an OBD as a unit of measure does not reflect the heterogeneity of the consumer [8]. While many attributes of the consumers will tend to be less variable between military facilities than between military and civilian facilities, many differences do exist. Age, sex and diagnostic characteristics of the patients, for instance, may vary between populations served by different medical facilities. Again, these differences are not accounted for by a single OBD measure.

Finally, OBDs is a measure which may be manipulated by the activity. Since total OBDs is a function of the number

of admissions and length of stay, an activity may show a reduction in cost per occupied bed day comparisons by increasing either the number of admissions, the length of stay or both. None of these practices may be desirable. As previously mentioned, an improvement in a measure should be due to improved performance, not to manipulation of the elements of the measure.

In view of the wide use of this measure and its ease of collection, several attempts have been made to improve this output measure [9,10]. These efforts include adjusting for case mix differences, stratifying the sample to group hospitals by the services provided and using the services provided as an explanatory variable. None of these methods have provided entirely satisfactory results [5,11,12].

Since it appears likely that some variation of the OBD unit will be used with the uniform chart of accounts, users should be aware of the deficiencies of this measure. It is suggested that a review of admissions (or discharges) and length of stay, perhaps in terms of population served, be included with the analysis of occupied bed days. This additional analysis should be feasible in view of the recent change to the uniform chart of accounts which requires the reporting of the number dispositions completed.

2. Visits

This performance factor is applicable to all ambulatory care accounts and occurs whenever an eligible beneficiary receives an examination, treatment, evaluation, counseling or

medical advice [3]. As a measure of output, this measure has also been criticized. McKinney submits that because outpatients receive care in outpatient departments, emergency rooms and in areas shared by both inpatients and outpatients, such as physical therapy, outpatient visit as a measure of services has led to confusion [13].

Although different capital and labor intensities appear to be a significant consideration when evaluating inpatient services, it may not be a factor when evaluating ambulatory services. Ruchlin and Levenson contend that research has indicated that adjustments for the clinic type are not warranted as they have no significant effect [13].

Like occupied bed days, visits also are capable of being manipulated by the activity. Unlike OBDs, developing counter measures for detecting or discouraging manipulation is more difficult. The deficiency of this measure must be recognized, however. It is suggested that visits be monitored over time to identify trends and that they be related to beneficiary population. For example, visits per 1000 members of the adjusted beneficiary population may facilitate comparisons between activities and discourage manipulation of this measure by the activity.

3. Ancillary Service Output Measures

Unlike the inpatient and ambulatory care functional accounts, the performance factor is not the same for all the accounts within the ancillary service functional category.

Measures of performance include procedures, weighted procedures, hours of service, visits and dollars of supplies. Since the output unit of measure varies, intra-hospital comparisons between the services based on performance measures are not likely to be meaningful.

Like occupied bed days and visits, the performance measures for the ancillary services are capable of being manipulated by the activity. A desire to improve its position with respect to a particular measure may motivate an activity to perform in an undesirable fashion. While an activity may be able to reduce its cost per unit of performance by increasing the number of units completed, it is generally more desirable to have the activity show improvement by reducing total costs.

As a means of discouraging manipulation of the various ancillary service output measures, it is suggested that the measures also be evaluated in terms of beneficiary population. An alternative method for monitoring the ancillary measures, not quite as desirable, is to place the measure in terms of visits and/or occupied bed days.

The deficiencies of the various surrogate measures of output included in the uniform chart of accounts have been discussed. The purpose of the discussion was not to totally discount the usefulness of the measures, but rather to identify certain deficiencies and to suggest possible alternatives to compensate for the deficiencies.

Due to limitations of the data, the time period to which it applied, and the time available to conduct an analysis,

adjustments to the measures and/or additional monitoring of the measures, as suggested, were not undertaken. Analysis of the relationships which included the measures discussed above utilized the performance factors as defined by the uniform chart of accounts.

D. COST/EQUIVALENT OCCUPIED BED DAY RELATIONSHIPS

Equivalent occupied bed days (synonymous with adjusted patient day) is a method of combining the inpatient and ambulatory workload into a common measure of output. Developed by the American Hospital Association, this conversion is used in various analyses in the annual publication Hospital Statistics [15], as well as selected issues of the monthly Hospitals publication [16]. In order to compute the total equivalent occupied bed days, outpatient visits are converted to equivalent occupied bed days and then summed with inpatient occupied bed days. Ambulatory visits are converted to equivalent occupied bed days on the basis of X number of ambulatory visits equal one occupied bed day [13]. This equivalence is derived from the ratio of hospital revenue from ambulatory visits to revenue from inpatient occupied bed days. Formulas which are applicable to this conversion are as follows:

$$\text{Equivalence Factor} = \frac{\text{Outpatient Revenue per Occupied Bed Day}}{\text{Ambulatory Revenue per Outpatient Visit}}$$

$$\text{Equivalent Occupied Bed Days} = \frac{\text{Number of Ambulatory Visits}}{\text{Equivalence Factor}}$$

$$\text{Total Equivalent Occupied Bed Days} = \text{Inpatient Days plus Equivalent Occupied Bed Days}$$

This measure of output was included since it is viewed as a means of facilitating comparisons at an aggregated level. This measure represents the services provided to both inpatients and outpatients and may be useful as a means of comparing activities which are intensive in one direction or another. This measure should be calculated using the combined data from all the activities. It should not be a facility specific measure when used for comparative purposes.

Since workload for the ancillary services is influenced by the number of visits and occupied bed days, this appears to be a means for accomplishing workload comparisons for the ancillary services at an aggregated level. Also, it appears that this measure may prove suitable for use in making workload based comparisons between the accounts within the ancillary service functional category. This measure, like the workload measure previously discussed, is deficient in that it can be manipulated

by an activity. In addition, the limitations of any single measure used at an aggregated level must be considered. While equivalent occupied bed days may have limited value in decision making, it appears suitable for use as a screening mechanism.

E. COST/PERCENTAGE RELATIONSHIPS

Cost/percentage relationship simply refers to a ratio of one cost with respect to another. For instance, the total cost of the inpatient medical care account with respect to the activity's total medical care cost is one cost/percentage relationship. Virtually hundreds of these relationships exist within the uniform chart of accounts. Ratios are useful in that they serve as a means of drawing attention to and highlighting relationships. However, ratios are meaningful and useful only when significant relationships exist between the figures selected for comparison [17].

The use of cost/percentage relationships as a means of analysis is included since initial examination of the UCA data produced ratios with a very small variance. This suggested that perhaps something in the UCA methodology caused the costs to be accumulated in the various accounts in the same proportions at all activities. It seemed unlikely that the proportion of funds spent in areas would be constant between activities.

Whether or not cost/percentage relationships prove to be suitable for making comparisons between activities, they may prove useful for monitoring an activity over time. It seems likely that the proportion of funds spent in various areas

should be fairly stable over time. A change in the spending pattern may serve to indicate that questions are in order. Cost/percentage relationships may also be valuable for determining where an activity's emphasis lies or the area of greatest demand. This could be useful for staffing purposes.

Use of historical cost/percentage relationships may be useful for budgetary purposes. If an activity indicates a need for funds which is contrary to the normal spending pattern, additional investigation may be warranted.

Like equivalent occupied bed days, the use of cost/percentage relationships may only be practical for screening purposes. This in itself may be valuable, however. Beginning 1 October 1979 the uniform chart of accounts will be implemented at all fixed medical treatment facilities world-wide. In view of the amount of data which will be generated, some means must be found to identify facilities which warrant attention first. Cost/percentage relationships may be such a means.

III. DATA ANALYSIS

In Chapter II, four types of cost relationships were presented. The composition of the relationship, the advantages, disadvantages and potential pitfalls of using the relationship were discussed. Where appropriate, suggestions were offered which may enhance the usefulness of the relationship as an evaluation technique. As pointed out in Chapter II, the relationships were largely a matter of supposition based on interviews with the originators of the uniform chart of accounts, review of the Military Health Care Study and review of the test draft of the Uniform Chart of Accounts for Military Medical Treatment Facilities. While the relationships discussed are not new or unique, they are largely untried or untested within the U.S. military establishment. The purpose of this chapter is to discuss the suitability of the various relationships for use as bases for making comparisons between activities and the services. Although many comparisons may be feasible, the comparisons must be meaningful. The discussion will be presented in three sections. Section A contains a description of the data used in the analysis as well as some specific problems encountered. A discussion of the methods which might be used to evaluate the relationships will be presented in Section B along with the rationale for choosing the methods actually used. Finally, the findings of the analyses, as well as the author's interpretation, will be presented in Section C.

A. DATA

The Uniform Chart of Accounts for Military Medical Treatment Facilities was implemented on a trial basis at ten military medical activities on 1 October 1977. The test sites involved included three Air Force, three Army and four Navy activities. An attempt was reportedly made by each service to select a mix of sites which would be representative of the range of medical facilities within its respective branch. Additional factors such as an unusual amount of borrowed labor or contracted services, unusual activity complexity and other factors were also considerations during site selection. The Air Force designated a clinic , a small regional hospital, and a medium-size medical center.[2] The Army designated a small and a medium base hospital and a large medical center. The Navy identified two small, one medium and one large medical center.

1. Origin

The data utilized in the analysis were provided through the courtesy of the three military services and represent the first and second quarters expense and workload figures for each of the ten test sites. During conversations with the

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[2]The categories of hospitals were arbitrarily established by the author on the basis of the number of authorized operating beds. While the Air Force considers the selections to be a small, medium and large medical facility, comparisons with the Army and Navy caused the sites to be categorized as clinic, small and medium facilities.

personnel involved in the UCA test, it was repeatedly stressed that the data for the first two quarters and possibly for the entire year should be viewed with caution. Users contend that when implementing any information system, initial output is bound to be fraught with errors and inconsistencies. The data on which the analyses are based, users feel, are no exception. The reports for the first and second quarters have generally been revised several times in an effort to provide a product which conforms to the letter and intent of the UCA. These revisions are not criticized, but rather recognized as a limitation on the inferences which can be drawn from the data used in this analysis.

The data provided by the military services were in the form of four reports generated by the uniform chart of accounts. Three reports presented data at a "subaccount level." The fourth report aggregated data to the "summary account" and "functional category" level. The first report entitled "statistics matrix" contains direct expense and performance factor data. The second report, the "step-down schedule," displays the process of allocating the intermediate operating expense accounts. The third report entitled "final purification," adjusts costs and workload incurred by one final operating expense account because of demands from another final operating expense account. An example would be the transfer of costs incurred by the psychiatric clinic account to the alcohol rehabilitation unit. The fourth report -- "The DOD Medical

Expense and Performance Report (MEPR)" -- is the only report presently designated by the uniform chart of accounts for submission to higher authority. The report contains total cost and performance data for the inpatient, ambulatory, dental and selected ancillary summary accounts and total cost data for the support service and special program functional categories.

2. Categories

The volume of data and limited time available for performing analysis necessitated that the data be reduced to a manageable level. It was therefore determined that analysis would be restricted to the summary account, functional category and aggregate activity level. Total hospital service costs and performance data were collected for each of the seven summary accounts for inpatient care, the twelve summary accounts for ambulatory care and the nine summary accounts for ancillary services. Total cost data was also collected for the functional categories of support services and special programs. This data was generally available from the "Medical Expense and Performance Report (MEPR)" although some manipulation of the other reports was necessary to obtain total cost and performance data for many of the ancillary service summary accounts. Expense information from the MEPR was reconciled with the other reports to the extent possible.

Direct expense data was also extracted for each of the previously identified accounts. This process required a

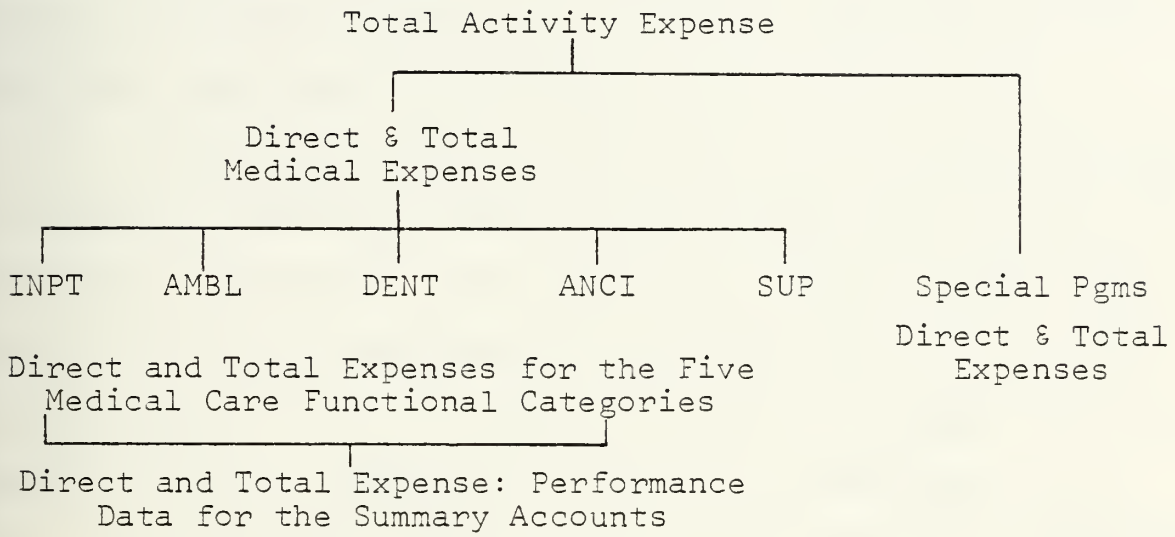
great deal of manipulation of the data contained in the "statistics matrix," "step-down schedule" and "final purification report" since the direct costs attributable to the subaccount level are not summarized at the summary account level prior to the step-down and final purification process.

To summarize, direct expense, total expense and performance data were extracted for each of the summary accounts for inpatient care, ambulatory care and ancillary services accounts. Total and direct expense data were collected for the special programs functional category and total expense data was collected for the support services functional account. Total direct expense, total overall expense and total performance data (where appropriate) for the inpatient, ambulatory and ancillary service functional categories were derived by summing the respective summary accounts. Total expense for the activity was derived by summing the total direct expense attributable to each functional category and then verified with the MEPR. Total and direct "medical expense" for the activity was defined as only those expenses incurred in rendering of health care services. The activity "medical expense" was derived by subtracting the total or direct special program expenses, as appropriate, from the activity total or direct expense. This breakdown of expenses may be represented graphically as a heirarchy as in Fig. 1.

The data from the above classification of expenses were used in various forms and groupings to analyze the cost relationships discussed in Chapter II.

Figure 1

Schematic of Expense Breakdown of Data



3. Problems

As might be expected due to the newness of the uniform chart of accounts information collection system, problems were encountered with the data. While many problems were minor and eventually resolved, one problem exists which may warrant further attention by higher authority.

It is the author's contention that anyone should be able to construct a Medical Expense and Performance Report (MEPR) from the data contained in the statistical matrix, step-down schedule and final purification report. In most instances this could not be done for the test sites. The difficulty encountered which prevented such a construction was

with the performance data for the ancillary services. While performance factors for the inpatient (occupied bed days), ambulatory (visits) and dental care (procedures) areas are well defined and generally small in number, this is not the case with the performance factors for ancillary services. Two problems were encountered in this area.

First, although the performance factor for an account is specified, guidelines have not been established for how the data shall be displayed. For instance, several accounts have "hours of service" specified as the performance factor. The values recorded ranged from hours of service in whole hours, in tenths of an hour, quarters of an hour, to hundredths of an hour. In one account, hours of service was recorded in minutes at two activities while another recorded units issued.

A second problem, related to the first, is the absence of a requirement that the performance values recorded in the statistics matrix equal the total units of performance produced for the period. The consequence of this was that many activities recorded a value obtained through sampling techniques which were used because the magnitude of the units performed made actual counts impractical. While sample values may be sufficient (provided accepted sampling techniques are used) for the allocation of costs during the step-down process, they do not permit the construction of cost/performance relationships for the account. In order to construct these relationships, expense and performance data should equal totals for the reporting period.

B. ANALYSIS

A variety of techniques are available for analyzing the UCA data. The advent of statistical packages, such as Statistical Package for the Social Sciences (SPSS) and SAS (Statistical Analysis System) [18,19] among others, have dramatically increased the accessability of statistical analysis. While these packages were useful to the author for obtaining an overall "feel" for the data, the unique configuration of the test data limited their usefulness for indepth analyses. This problem will be described further during the discussion of the analysis design.

1. Method Description

Several methods exist for analyzing data of a multiple category nature. The method chosen by the author was analysis of variance (anova), a powerful technique for making comparisons between two or more groupings of data. In the anova, data are classified, cross-classified and then tested to determine if the means of a particular classification differ significantly [20]. In this testing, the anova gives attention to the overlapping nature of the data and determines whether the data of a classification overlap so much that there is no difference between the groupings. For example, suppose an investigator desires to test the effectiveness of three brands of drugs on a single group of test subjects with the drugs administered in a random manner. If there is no difference in one drug over another then one can state that the mean (effectiveness) of

Drug 1 = Drug 2 = Drug 3; i.e., H(0): $\mu_1 = \mu_2 = \mu_3$. If true, then the brands of drugs could be treated as a single drug and any variation which occurred in the test could be attributed to the test subjects and not the drug. The anova enables such a comparison.

There are several variations or designs of the analysis of variance such as "one-way anova," "two-way anova," "latin square" and others. The above example was a "one-way" design. Only the effects of one factor (drugs) were considered. In a "two-way" design one might look at the effect of two factors such as drugs and the time of day administered. The particular design determined to be appropriate for analysis of the UCA data was the "nested" design which will be described through the use of an example.

Suppose, as in our example above, that an investigator desires to compare the effectiveness of three drugs. Each of the drugs is to be administered to an equal number of patients in each of six hospitals. Using an anova two-way design to analyze the data, the investigator would be confronted with three effects. There would be an effect due to the drug, an effect due to the hospital and an effect due to an interaction between the effects of the drug and the effects of the hospital. Now if the example were changed such that Drug 1 was only administered to patients in Hospitals 1 and 2, Drug 2 only to patients in Hospitals 3 and 4, and Drug 3 only to patients in Hospitals 5 and 6, there would only be two effects.

The investigator could identify the effects due to the drug and the effects due to the hospital, but the interaction effect between the drugs and the hospitals could not be determined. The effect of the hospitals is said to be "nested" within the drug factor. In order for the interaction effect between the drugs and the hospitals to be determined, each drug must be tested in each of the hospitals.

The justification for using the "nested" design in analyzing the UCA data follows similar reasoning. Suppose it is desired that the effects of size and service be analyzed through the use of the UCA data. Although each service may have a small, medium and large hospital, a small Air Force hospital is not exactly a small Army hospital or a small Navy hospital. Since the "size" factor is service specific, the "size" effect is nested within the "service" effect. A more indepth discussion of the nested design is contained in Appendix B.

2. Method Design

Due to the small number of activities being tested, the ways in which meaningful comparisons could be made were limited. It was not possible to compare small Air Force hospitals with one another, for instance, since there was only one included in the test. Although comparisons could have been made between the different size hospitals within a service, such comparisons would be of questionable value and validity due to the small number of activities considered. Therefore

it was decided that comparisons would be restricted to comparisons between the services using the nested design previously discussed. This design enabled the use of a maximum sample size while making maximum use of the data.

Each hospital was classified by size and service. Classifying hospitals by size provided one clinic, four small hospitals, three medium hospitals and two large hospitals. Since only one clinic existed, it was not possible to make meaningful comparisons. Hence, the clinic was eliminated from the analysis. The design for analyzing data from the nine remaining activities is represented schematically as in Fig. 2.

Figure 2

Design for Arrangement of Data

	AIR FORCE			ARMY			NAVY		
	S	M	L	S	M	L	S	M	L
Qtr 1 & 2	1	2		1	2	3	1*	2	3

S = Small M = Medium L = Large

* = Data from two activities

Utilizing the above design, appropriate sum of squares and degrees of freedom were calculated and placed in the generally accepted format used when computing an "F" statistic. The particular format used is shown in Fig. 3 [21].

Figure 3

Format for Displaying F Statistic Computations

Source of Variation	D.F.	SS	MS	F
Between Sizes	7			
Service	2	*		
Size within Service	5	*	—	—
			—	—
Within Sizes	10			
Error	10	*		
			—	
TOTAL	17			

* Sum of squares values computed for the particular variables being tested using the previously described design.

SS (Sum of Squares) equals the sum of the squares of the deviations of the sample values from their sample mean.

MS (Mean Square (also called the variance)) equals the sum of squares divided by its degrees of freedom which is an averaging of the squared deviations from the mean.

F (the "F" statistic) which in this analysis is equal to the MS (service or size within service) divided by the the MS (error); i.e., MS(SER)/MS(ERROR).

D.F. (Degrees of Freedom) which is equal to the number of elements in the category minus one. For instance, the number of elements for size within service was computed as follows:

Air Force (two size categories) - 1	= 1
Army (three size categories) - 1	= 2
Navy (three size categories) - 1	= 2
Total D.F. for size within service	= 5

Once an F statistic was computed for the service and size within service categories, the statistic was compared with a table value for F at the appropriate degrees of freedom for the numerator and denominator and at the desired level of significance. These table values were constant throughout the analysis since they depend on the number of degrees of freedom. An F statistic which exceeds the table value for F is considered to be significant which means that there is a significant difference between the means of the samples being compared at the given level of confidence.

3. Comment on the Use of the Anova

Two comments appear warranted at this time. First, as with most statistical tests, results from the anova may be misleading. For instance, if the range of values for one activity vastly overshadows all other sample values in the test, the anova may lead the investigator to conclude that there is no significant difference between the services and/or size hospitals within the service. For this reason it is suggested that the investigator review the data for obvious characteristics by means of plots, scattergrams or whatever means available. For example, in one instance the data values ranged from 20 to 1800 for one activity while the values of the other activities ranged from 20 to 50. In this instance "no significance difference" would be found because the range of values for the one activity "overwhelmed" the values of the other activities. It should be noted that the range does not have to be this extreme.

Second, it should be recognized that the anova only indicates that there is a difference somewhere. It does not indicate where that difference lies. In order to determine the location of the difference, alternate methods such as the studentized range statistic [22] must be used.

4. Data Transformation

Comparisons were made between services with respect to the proportion of the activity's total expenses and total medical expenses spent in the various areas. The problem with evaluating proportions is that the investigator must deal with values between 0 and 1 and generally with a very small range. To combat this difficulty, Winer [22] recommends the use of an arcsin transformation of the proportions. This transformation has an additional advantage in that it is effective in stabilizing the variances. The data transformation for the percentage comparisons for this thesis was accomplished utilizing the following formula:

$$X_{ijk} = 2 \arcsin \sqrt{X_{ijk}}$$

where X_{ijk} is a proportion.

Arcsin is equaivalent to the notation $\sin^{-1}$ (read inverse sine).

C. FINDINGS

In Chapter II four cost relationships were presented which were conjectured to be suitable for facilitating comparisons between activities which utilize the Uniform Chart of Accounts for Military Medical Treatment Facilities. Utilizing the nested

design of anova for analyzing the data from nine test sites, comparisons were made between the services for each of the cost relationships discussed in Chapter II. The object of these comparisons was to determine, to the extent possible, the suitability of the cost relationships as a basis for evaluating activities. The discussion of the findings will be presented in two parts. In Section 1, the hypothesis under consideration and the interpretation of the results will be presented. The findings for each of the cost relationship categories will be presented in Section 2.

1. Hypothesis and Interpretation

The null hypothesis used to provide direction for testing was that there was no difference between the services with respect to the particular cost relationship being evaluated. The alternate hypothesis was that there was a difference between services. In most tests of a hypothesis, the investigator desires to reject a null hypothesis of no difference between populations. For instance, if a machine which produces rods within a particular tolerance range is adjusted, the investigator would desire to reject a null hypothesis of there being no difference between rods produced before and after the machine was adjusted. The investigator would hope to show that, after adjustment, the machine produces a significantly better quality rod.

In evaluating the cost relationships discussed in Chapter II, an opposite approach is taken. In order to show

the usefulness of a measure as a basis for making comparisons, it is desirable that the null hypothesis of no difference be accepted.[3] For instance, if a comparison of the activities is made using occupied bed days, it is desired that the null hypothesis of "no difference" be accepted. However, the emphasis is not on the finding that there is no difference between activities. Rather, it is on the fact that the measure enabled a comparison of the activities. It may be unrealistic for a measure to show "no difference" in all cases. Such a measure may be suspected as being biased. By the same token, a measure being evaluated should not show that there is a significant difference in all instances either. If the measure always showed a difference between groups, it would have little value as a tool for making comparisons.

An understanding of the difference between the above two approaches is necessary in order to interpret the results obtained from the analysis of variance. A better understanding of the results to be presented can perhaps be achieved through a brief explanation of the F statistic and the significance level. Following this discussion, an explanation of the difference between "service" comparisons and "size within service" comparisons will be discussed. As an example, suppose that an

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[3]More properly, one does not "accept" the null hypothesis, but rather "fails to reject" the null hypothesis.

anova is conducted on the cost per outpatient visit for the surgical service with the following result:

$$\frac{\text{MS (Service)}}{\text{MS (Error)}} = \text{F Statistic of } 1.01$$

(Degrees of Freedom = 2/10, denoted as F(2,10))

$$\frac{\text{MS (Size in Service)}}{\text{MS (Error)}} = \text{F Statistic of } 2.37$$

(Degrees of Freedom = 5/10, denoted as F(5,10))

The table values for F at the appropriate degrees of freedom are as follows:

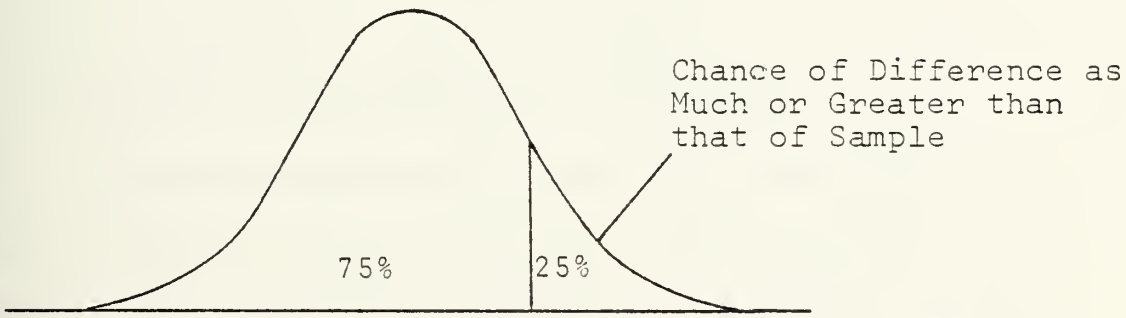
Level of Significance	Value F(2,10)	Value F(5,10)
.75	1.60	1.59
.90	2.92	2.52
.95	4.10	3.33
.99	7.56	5.64

Comparing the computed F statistic with the table value of F, it is noted that in the first instance the computed value is less than the table value for the 75th percentile. In this instance, we could not reject the null hypothesis that there is no difference between the costs for an outpatient surgical visit between the services. It could also be interpreted to mean that we could expect as much or greater a

difference 25% of the time if the samples came from the same population. This may be represented graphically with a density function for a normal distribution as in Fig. 4.

Figure 4

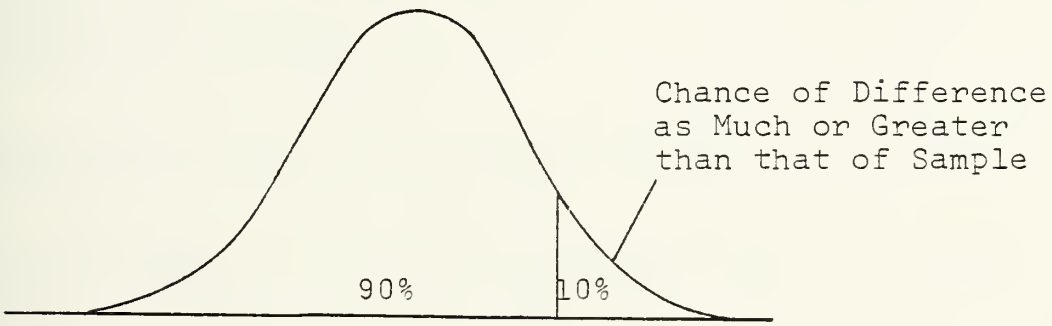
Density Function for Normal Distribution with 75th Percentile Significance Level



In the second instance, the computed value for the F statistic is greater than the table value for the 75% level of significance, but less than the table value for the 90% level of significance. In this instance the null hypothesis that there is no difference in the cost per visit can be rejected at the 75th percentile, but the null hypothesis cannot be rejected at the 90th percentile. In this case a difference in the samples of an equal or greater amount than that of the samples would be expected only 10% of the time if our samples are from the same population. In this instance the graph would appear as in Fig. 5.

Figure 5

Density Function for Normal Distribution
with 90th Percentile Significance Level



From these examples it should be clear that the higher the "level of significance" the less chance there is for samples from the same population to exhibit the amount of difference shown. It should also be clear that for the purpose of this thesis, the lower the level of significance the better. We would rather say that we would expect to see a difference equal to or greater than the amount found 25% of the time, rather than only 5% or 1% of the time. Therefore, the levels of significance to be presented reflect the lowest level that the null hypothesis could not be rejected down to the 75th percentile. This is commonly referred to as significance testing.

Prior to a presentation of the findings an explanation of the difference between "service" comparisons and "size within service" comparisons is warranted. If a comparison is made between costs for an outpatient surgical visit and it is determined that the "between service" variation is not significant,

one may interpret this to mean that the average cost for an outpatient surgical visit in the Air Force is not significantly different from the average cost for an outpatient surgical visit for the Army or for the Navy. This may be represented mathematically as follows:

$$\text{Average Cost} = \bar{X}_{\text{Air Force}} = \bar{X}_{\text{Army}} = \bar{X}_{\text{Navy}}$$

Continuing the example, if it is determined that the "size within service" variation is not significant, a slightly different interpretation may be made. In this instance, the test indicates that there is no significant difference in the average cost for an outpatient surgical visit within the Air Force or within the Army or within the Navy without regard to the difference between the Air Force and the Army and the Navy. A significant difference would indicate that one or more of the services should investigate the variation in the costs within the service.

2. Results

In this section, the results of comparisons between the services in terms of the cost/population, cost/output, cost/equivalent occupied bed day, and cost/percentage relationships will be presented and discussed in five sections. Section a will present the results of comparisons made at the aggregate level (functional category and total activity level). Section b will discuss comparisons between inpatient summary accounts.

Section c will discuss comparisons between the ambulatory care accounts. Comparisons between the ancillary care accounts will be discussed in Section d. Finally, a discussion of the findings will be presented in Section e.

a. Aggregate Analysis

The cost categories examined were:

Total and direct activity cost

Total and direct inpatient cost

Total and direct ambulatory cost

Total and direct ancillary cost

Total and direct special program cost

Total support service cost[4]

The performance categories used were equivalent occupied bed days, UCA performance factors, population served, and cost percentage relationships.

Two rates were used for converting visits to equivalent OBDs. A rate of 5.74 visits = 1 OBD was the conversion rate used by the American Hospital Association as cited in research by Frank [17]. A rate of 9.184 visits = 1 OBD was also used and was derived using the conversion formula discussed in Chapted II and the data generated by the uniform chart of accounts.

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[4]Total cost and direct cost are equivalent for the support service category.

Only two performance factors specified by the UCA are suitable for use at an aggregate level. Occupied bed days may be used as an aggregated total as the performance factor for inpatient care and visits may be used as an aggregated total as the performance factor for ambulatory care.

Population data were obtained from previous work completed by Brown and Roman [23]. While each service has developed patient catchment areas for their service, the data produced for the Office of the Secretary of Defense (Health Affairs) by CSF Limited was utilized since it appeared least susceptible to multiple counting of beneficiaries in instances where facilities of more than one service were present in an area.

Two cost figures were used as a denominator in the computation of cost percentages. Activity total cost represented the total expenses incurred by the activity in all areas. Medical cost was computed to be the total activity expenses less the expenses for special programs. Percentages were computed on the total costs for a category and not the direct costs.

The results of the statistical analyses are presented in Table I. The "A" column refers to that portion of the anova test which evaluates the difference between services. The "B" column refers to the portion of the anova test which evaluates the size within service differences. The percentages listed indicate the level of significance at which

Table I

Total Activity and Functional Category Analyses

	COST RELATIONSHIP															
	Equivalent OBDs AHA Rt/Act. Rt				Performance Factors OBDs				Population		Percentage Ratio Act. T /Med.Care					
							Visits									
	A	B	A	B	A	B	A	B	A	B	A	B	A	B		
T Activity Cost	-	-	.75	.99					-	-						
D Activity Cost	-	-	-	-					-	-						
T Inpatient Cost	-	-	-	-	.95	.99			-	-	-	-	-	-		
D Inpatient Cost	-	.90	-	.99	-	-			-	-						
T Ambulatory Cost	-	.99	-	.99			.95	-	.99	-	-	-	-	-		
D Ambulatory Cost	-	.75	.99	.75			-	-	.99	-						
T Ancillary Cost	.95	-	.99	-					-	-	.75	.99	.99	.99		
D Ancillary Cost	.75	-	.90	-					-	-						
T Special Programs Cost	-	-	-	.99					-	-	-	-	-	-		
D Special Programs Cost	-	-	-	-					-	-						
T Support Service											.95	.75	.90	.90		
Number not Significant	2	3	4	5	1	1	1	0	2	0	2	2	2	2		
Number Tested	10	10	10	10	2	2	2	2	10	10	5	5	5	5		

- = indicates that a significant difference was found at 99% level
A = Comparison "between service"
B = Comparison of "sizes within services"
T = Total costs
D = Direct costs

the null hypothesis of no difference could not be rejected. A hyphen indicates that a statistical test was performed and that there was a significant difference between either the service or the within service variation, as appropriate. The first total at the bottom of the table indicates the number of instances in which the test found no significant difference. The second total indicates the number of areas which were evaluated. This format will be followed in subsequent tables.

Although activities were compared at the aggregated level with all relationships, only when equivalent OBDs were used (at a ratio of 9.184: 1 OBD) was no significant difference found between the services and with respect to within service variation. A finding of "no significant difference" was obtained in more instances with cost/equivalent OBD comparisons than with other relationships at this level of analysis. This finding was obtained more often in comparisons of direct costs. A finding of no significant difference was found in 3 of 8 comparisons using the two performance factors of occupied bed days and visits. Performance factors suitable for aggregate comparisons were only available for the inpatient and ambulatory functional category. A finding of no difference was only obtained for the ambulatory care category using cost/population relationships and only in the ancillary and special program categories using cost/percentage comparisons.

b. Inpatient Care Analysis

Each of the seven summary accounts of the inpatient care functional account was evaluated in terms of total and direct costs and the three performance measures of equivalent occupied bed days, occupied bed days and population served. Cost percentages were computed for the summary account total cost. As in the previous section, analyses with respect to equivalent OBDs were conducted using both the rate established by the American Hospital Association (AHA) and the rate computed from the UCA data. The results of the statistical analysis for the inpatient care summary accounts are presented in Table II.

Comparisons with the performance factor for the inpatient summary accounts resulted in a finding of no significant difference only slightly more often than the other measures. This also was the only measure in which there was no difference between the services in every category at the total expense level. All the comparisons showed no difference between the services slightly more often than between variation within the services. Comparisons of cost/equivalent OBD relationships which were computed based on the UCA data resulted in a finding of no difference slightly more often than the AHA equivalent OBD rate. The performance factor was much better at achieving a finding of no difference with comparisons of total cost rather than direct cost while the other measures were generally equivalent for total and direct cost comparisons. As in the previous table, a hyphen indicates that a statistical test was

Table II

Inpatient Care Summary Account Analyses

		COST RELATIONSHIP											
		Equivalent OBDs AHA Rt/Act. Rt				Performance Factor OBDs		Population		Percentage Act. T/Med. Care		Ratio Care	
		A	B	A	B	A	B	A	B	A	B	A	B
Medical	T	.75	-	.75	-	.95	.90	.75	-	.90	-	.90	-
	D	.75	.99	.90	.95	-	.99	-	.75				
Surgical	T	-	-	-	-	.90	.99	-	-	-	-	-	-
	D	-	-	-	.99	-	-	-	-				
OB/GYN	T	-	-	.90	-	.75	.90	.99	-	-	-	-	-
	D	-	-	-	-	.95	-	-	-				
Pediatric	T	.75	-	.75	.99	.90	.95	-	-	.90	.99	.90	.99
	D	.75	-	.75	-	.90	.90	-	-				
Orthopedics	T	.75	.99	.75	.99	.95	-	.90	-	.75	.99	.75	-
	D	.95	.99	.95	.99	-	-	.95	.95				
Psychiatry	T	.99	.99	.99	.99	*	*	.99	-	.99	.90	.99	.90
	D	.95	.75	.95	.75	*	*	.99	.75				
EENT	T	-	-	-	.99	.75	-	-	-	-	.95	-	.99
	D	-	-	-	-	.75	-	-	.95				
Number not significant		8	5	9	8	9	6	6	4	4	4	4	3
Number Tested		14	14	14	14	14	14	14	14	7	7	7	7

* = Not significant at 99th percentile unless one extreme value excluded.

performed and that there was a statistical difference between the categories.

c. Ambulatory Care Analysis

Total and direct costs were calculated for each of the twelve summary accounts of the ambulatory care functional category. The performance categories used in the analysis were equivalent OBDs, visits and population served. Again, cost percentages were calculated for summary account total costs only. Analysis could not be conducted for the family practice (BH), flight medicine (BK) and underseas medicine (BL) summary accounts due to insufficient data points. Unlike previous analysis, the ambulatory care accounts were only evaluated in terms of the equivalent OBD rate based on UCA data. The rate used by the AHA did not appear to provide as suitable results as the UCA based rate and was therefore dropped from further analysis. Comparisons with the UCA based rate suggested no difference more often and generally had the values more evenly spread between the service category and within service category in the analysis. The AHA rate was included in the aggregate analysis and inpatient analysis for comparative purposes. The results of the analysis of the ambulatory care functional category are presented in Table III.

Unlike the summary account analysis for the inpatient functional category, no measure produced a finding of no difference for all total cost and direct cost comparisons. One relationship appeared as likely to produce a finding of no

Table III

Ambulatory Care Summary Account Analyses

		COST RELATIONSHIP									
		Equivalent OBDs Activity Rate		Performance Factor Visits		Population		Percentage Ratio Act.T / Med.Care			
		A	B	A	B	A	B	A	B	A	B
Medical	T	-	-	-	-	.99	-	#.75	.75	-	-
	D	-	-	.95	.90	.95	-				
Surgical	T	-	-	.99	.99	.99	-	-	.95	-	-
	D	-	.99	-	.99	-	-				
OB/GYN	T	.99	.99	.75	.75	-	-	.95	.99	.75	.90
	D	.75	.90	.75	.90	.99	.95				
Pediatrics	T	.95	.99	.99	.95	-	-	.95	.95	.99	.95
	D	.95	.95	-	.90	.75	-				
Orthopedics	T	.99	.99	.99	-	.90	-	-	-	.99	.95
	D	.75	-	.95	-	.95	-				
Psychiatry	T	.99	-	-	-	.99	-	-	-	.75	.90##
	D	-	-	-	-	-	-				
EENT	T	.75	.75	-	.99	.99	-	.90	.99	.99	-
	D	.99	-	.99	.99	-	-				
Family Practice	T	I		I		I		I		I	
	D	I		I		I					

I = Insufficient data points for analysis
# = One activity excluded "A" not significant at 95% level with the activity
= One activity excluded. Significant difference with the activity.

Table III (cont.)

		COST RELATIONSHIP									
		Equivalent OBDs Activity Rate		Performance Factor Visits		Population		Percentage Ratio Act. T/Med. Care			
		A	B	A	B	A	B	A	B	A	B
Preventive Medicine	T	-	-	.99	.99	-	-	##-	.95	-	.95##
	D	.99	-	.75	.95	-	-				
Emergency Medicine	T	.99	-	.90	-	-	-	-	.75	.99	-
	D	.75	.99	.75	-	.90	.95				
Flight Medicine	T	I		I		I		I		I	
	D	I		I		I					
Undersea Medicine	T	I		I		I		I		I	
	D	I		I		I					
Number not Significant		12	8	12	11	10	2	4	7	6	5
Number Tested		18	18	18	18	18	18	10	10	10	10

no difference as any other whether comparing direct costs or total costs. With the exception of the comparison of direct psychiatric costs, a finding of no significant difference between the services was obtained for both cost categories by at least one or more of the cost relationships. The "I" in the table indicates the inability to perform a meaningful statistical analysis due to insufficient data points. This occurred because some activities did not perform the particular function.

d. Ancillary Care Analysis

Total and direct costs were calculated for each of the nine summary accounts for the ancillary care functional category. The performance measures of equivalent OBDs, population served and cost percentages are the same as previously discussed. The performance factor specified in the UCA varies for the summary accounts of the ancillary care category. The problems incurred in obtaining uniform performance data for the accounts of this category were discussed in Section A-3 of this chapter. The results of analyses of the ancillary care accounts are presented in Table IV. Analyses could not be conducted for the same-day service (DG) or the nuclear medicine account (DI) due to insufficient data points. This is indicated by the "I". Analysis of the cost per UCA performance factor could not be conducted in the special procedures (DD), surgical services (DE) and central sterile supply/material service (DF) due to "varying methods" of representing the number of units produced.

Table IV

Ancillary Care Summary Account Analyses

		COST RELATIONSHIP									
		Equivalent OBDs Activity Rate		Performance Factor		Population		Percentage Ratio Act. T/Med. Care			
		A	B	A	B	A	B	A	B	A	B
Pharmacy	T	.99	.99	.90	.75	-	-	.90	-	.95	.99
	D	.90	-	.99	.90	-	-				
Pathology	T	.75	.99	.99	.90	.90	-	.90	.75	-	-
	D	-	-	-	.90	.95	-				
Radiology	T	.99	.95	.95	.95	.90	.99	.99	.90	.90	.90
	D	.99	.95	.95	.99	.99	-				
Special Procedures	T	-	.90	VM		-	-	-	-	-	-
	D	-	.95	VM		-	-				
Surgical Services	T	.99	-	VM		.75	-	.75	.75	-	.99
	D	-	-	VM		.90	-				
Sterile Supply	T	-	-	VM		-	-	.99	.99	.99	.99
	D	-	-	VM		-	-				
Same Day Services	T	I		I		I		I		I	
	D	I		I		I					
Rehabilitation Services	T	-	-	VM		-	-	.99	.99	-	.99
	D	-	-	VM		-	-				

VM = Varying methods of recording performance data

Table IV (cont.)

		COST RELATIONSHIP									
		Equivalent OBDs Activity Rate		Performance Factor		Population		Percentage Act. T/ Ratio Med. Care			
		A	B	A	B	A	B	A	B	A	B
Nuclear Medicine	T	I		I		I		I		I	
	D	I		I		I					
Number not significant		6	6	5	6	6	1	6	5	3	5
Number Tested		14	14	6	6	14	14	7	7	7	7

The performance factor was the most effective basis for obtaining a finding of no difference for those comparisons which could be made. Unfortunately, only three summary accounts could be evaluated due to the various methods in which performance data was recorded. Those accounts for which performance factor comparisons could not be made for this reason are indicated by the "VM". The equivalent OBD relationship enabled the comparison of more categories and produced results similar to the performance factor comparisons for the pharmacy, pathology and radiology accounts. The population served measure produced findings similar to the equivalent OBD measure for between service comparisons, but only found no difference in one within service variation. Percentage ratios appeared to be a useful basis with which to make comparisons in this area. As in the previous table, the "I" indicates insufficient data to perform the analysis.

e. Discussion of the Results

The results of the analyses which were conducted were presented in Tables I through IV. These results will be summarized in Table V.

Evaluation of the accounts using total costs enabled a finding of "no significant difference" only slightly more often than when direct costs were used. This was true for comparisons of differences between the military services in all instances and generally for the size within service comparisons. An exception was the cost/population served and

Table V

Summary of Statistical Analyses

Level of Analysis	Cost Category	Equivalent OBDs AHA rate # Tests	Not Sig A	Not Sig B	Activity rate # Tests	Not Sig A	Not Sig B	Performance Factors # Tests	Not Sig A	Not Sig B
Total & Functional	Total	5	1	1	5	2	3	2	2	1
	Direct	5	1	2	5	2	2	2	-	-
Total Tests		10	2	3	10	4	5	4	2	1
Inpatient Care	Total	7	4	2	7	5	4	7	6	4
	Direct	7	4	3	7	4	4	7	3	2
Total Tests		14	8	5	14	9	8	14	9	6
Ambulatory Care	Total				9	6	4	9	6	5
	Direct				9	6	4	9	6	6
Total Tests					18	12	8	18	12	11
Ancillary Services	Total				7	4	4	3	3	3
	Direct				7	2	2	3	2	3
Total Tests					14	6	6	6	5	6
# "Total Cost" Category		12	5	3	28	17	15	21	17	13
# "Direct Cost" Category		12	5	5	28	14	12	21	11	11
Cost Relationship Total		24	10	8	56	31	27	42	28	24

Tests = number of statistical tests performed on the classification.

Not Sig A,B = number of instances in which a finding of no difference was obtained.

Table V (cont.)

Level of Analysis	Cost Category	Population # Tests	Population Not A	Population Sig B	Percentage Ratio Act. Total # Tests	Act. Total Not A	Act. Total Sig B	Med. Care # Tests	Med. Care Not A	Med. Care Sig B
Total & Functional	Total	5	1	-	4	2	2	4	2	2
	Direct	5	1	-						
Total Tests		10	2	-						
Inpatient Care	Total	7	4	-	7	4	4	7	4	3
	Direct	7	2	4						
Total Tests		14	6	4						
Ambulatory Care	Total	9	5		10	4	7	10	6	5
	Direct	9	5	2						
Total Tests		18	10	2						
Ancillary Services	Total	7	3	1	7	6	5	7	3	5
	Direct	7	3	0						
Total Tests		14	6	1						
# "Total Cost" Category		28	13	1	28	16	18	28	15	15
# "Direct Cost" Category		28	11	6						
Cost Relationship Total		56	24	7	28	16	18	28	15	15

cost/AHA equivalent OBD relationships. It appears that either direct or total costs are suitable for comparing activities although total costs have a slight edge.

A finding of no significant difference was obtained more often for the between service category than for the size within service category except for the direct cost/AHA equivalent OBD comparison which had equivalent results. There may be less of a difference between the services overall than there is variation within the service. In other words, the degree of variation within one branch of service appears to be significantly different from the variation of costs within the other branchs of service.

Comparison of the summary accounts for the inpatient care functional category resulted in a finding of no difference a greater proportion of the time than in other categories. This was followed by comparisons within the ambulatory care area, the ancillary care area and finally, by comparisons at the aggregate and total activity level. This is understandable in view of the well defined nature of the inpatient and ambulatory care areas, somewhat less defined nature of ancillary care and the nebulousness of aggregate and total activity comparisons.

Comparisons on the basis of UCA defined performance factors had a slight advantage over equivalent occupied bed days. However, equivalent occupied bed days is a much more versatile measure of performance since it is not restricted

to a particular account or class of accounts. Comparisons of any two or more UCA accounts are possible and are certain to be more meaningful than comparison of accounts with different performance measures. Although cost/percentage relationships were not very useful as a basis for comparison at an aggregate level, the relationship performed satisfactorily at the summary account level.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The Uniform Chart of Accounts for Military Medical Treatment Facilities (UCA) is viewed as a means of obtaining uniform expense data from medical facilities of the three services. Undoubtedly the UCA offers many capabilities beyond those of the present system. Data from the UCA should enable the activities, the medical departments of the three services, the Department of Defense and possibly Congress to have more confidence that similar expense issues are being discussed. The UCA should do much to reduce comparisons of "apples" and "oranges" and improve the comparability of the facilities. Much remains to be done, however, to ensure that activities are compared on an equivalent basis. A question which must eventually be asked is what might be done with the data which is generated by the UCA?

The initial two objectives of this thesis were to first, identify the types of analyses conducted by the health care community with respect to medical facilities and second, determine the data requirements of the various methodologies to determine if the UCA could support such analyses. A search of the literature revealed that while a portion of the information necessary could be provided by the UCA, it was not sophisticated enough to provide all the data required. In view of this finding, it appears that comparisons with the civilian community

will be extremely limited until the UCA obtains a higher level of data gathering capability. The objective of the thesis evolved to that of constructing a specific methodology which utilized the UCA-generated data. In developing this methodology, primary emphasis was placed on the recommendations of the Military Health Care Study [3] and the data capabilities of the UCA.

Four categories of cost/performance relationships are offered which appear to provide suitable bases for comparisons. The four categories are (1) cost/beneficiary population relationships, (2) cost/output relationships, (3) cost/equivalent occupied bed day relationships and (4) cost/percentage relationships.

Cost/beneficiary relationships have the advantages of being less manipulable by the activity, being suitable for use throughout the activity and not creating perverse incentives. They have the disadvantage of not taking into account the cultural and demographic differences exogenous to the organization without further refinement.

Cost/output relationships have the advantage of availability. The UCA specifies uniform output measures for use at the activity. Also, output measures reflect to some degree the cultural and demographic factors of the facility. The principle disadvantages of the output relationships are that they are manipulable and they may create perverse incentives which may encourage the organization to do the wrong thing.

Cost/equivalent occupied bed day relationships have several advantages. First, they utilize the performance information already produced by the activity. Since the measure represents the principle output produced by the facility, it appears to be suitable for use in areas other than just inpatient and ambulatory care. Third, it appears suitable for use as an activity measure and as an aggregate measure for the functional categories. The relationship has the disadvantages of being manipulable and that manipulation may be difficult to detect.

The fourth category -- cost/percentage relationships -- may be most valuable for monitoring activities over time. Percentages have the advantage of only requiring one type of information. The measure also offers a simple means for placing activities on a comparable basis. The primary disadvantages are that the measure may be activity specific and that the percentage comparison may not be meaningful.

Comparisons were made between nine of the ten activities involved in the one year UCA test. The limitations on using data from the first two quarters of a system test have been discussed. It has not been the intent of the author to arrive at concrete conclusions concerning the measures or to suggest that the relationships should be used for decision making. Rather, the intent has been to suggest a means by which activities which warrant attention can be identified. In other words, the methodology suggested may have value for screening activities.

Comparisons were made utilizing the nested design of the analysis of variance. The nested design appears to be the most appropriate means for making comparisons between the services since the "size" designation is service specific and is "nested" within the service. It may be noted that the two-way analysis of variance is the appropriate means of making comparisons at an aggregate level between activities within a branch of service, but the nested design is again appropriate when making "between activity" comparisons of functions within the activity such as the functional categories or summary accounts.

In view of the findings of the many analyses which have been conducted, it is the author's opinion that the measures which have been presented warrant consideration as bases on which to make comparisons between the activities and the three services.

Equivalent occupied bed day relationships were shown to be particularly useful for making comparisons at a total activity and aggregate functional category level. In addition, equivalent OBDs generally provided results comparable to the performance factors specified by the UCA but was a much more versatile measure. Further, although "no significant difference" was found a greater percent of the time when the performance factors specified in the UCA were used as a test basis, it should be noted that no comparisons could be made at the total activity level and only four comparisons could be made at the aggregate (functional account) level. In addition,

even though the performance factor was specified for the ancillary accounts, comparisons had to be limited to those accounts which had workload data contained in the DOD medical expense and performance report due to the data problems previously discussed.

Finally, it can be noted that no one measure completely overshadows the other measures as a tool with which to make comparisons. In fact, it appears that the measures are somewhat complementary.

Comparisons with performance factors specified by the UCA resulted in findings of "no difference" more often than with the other relationships. However, the performance factor did not dominate the other measures.

Comparisons made using population based relationships did not perform as well as the performance factors or equivalent OBDs, but like equivalent OBDs, has the advantage of versatility. It appears that an "adjusted" population served relationship will be necessary before meaningful comparisons will be able to be made.

The use of total costs for comparisons resulted in a finding of no difference more often than when direct costs were used. This suggests that the UCA methodology makes facilities "more comparable" on a total cost basis than on a direct cost basis. This may or may not be a desirable result of the UCA. In view of the narrow margin of difference, this conclusion may be premature. In addition, since the quality

of the data is suspect, further evaluation of the measures may be warranted.

Evaluation of activities on the basis of cost percentages compared favorably with evaluations using other relationships. Summary account costs as a percent of the activities total costs appeared to be as suitable a comparison measure as summary account costs as a percent of the total activity medical care costs.

B. RECOMMENDATIONS

In the process of analyzing the UCA and the data generated by the ten test sites, several issues came to light which may warrant further attention and/or research.

First, review of the literature revealed a need for far more extensive data than the UCA is capable of providing at this time. The strategy of providing a framework as early as possible and then building upon it is certainly valid. However, prior to expanding the capabilities of the UCA, it is suggested that the specific comparisons which are desirable be identified and that the UCA be expanded to meet the data requirements of these comparisons. Failure to do so may result in a system which collects data uniformly, but restricts comparisons to within the organization.

Second, one of the first problems encountered during analysis of the UCA data was determining the categories for which comparisons could be made. Although size was selected as one of the bases for comparisons, the size categories were

somewhat arbitrarily based on bed size. One problem with this criteria is that it is freely adjusted by the military services. Further, while size accounts for many of the characteristics which affect an organization, there are many more factors which are not accounted for. This point is discussed further in Appendix B. It is suggested that research be done to establish uniform "peer" group categories which encompass the many internal and external factors -- of which size is only one -- which influence the operation of the organization. Each "peer group" would contain facilities with similar exogenous and endogenous characteristics. The "peer group" categories should improve the capability to make equivalent comparisons.

As previously stated, it is the author's contention that the information necessary to construct a DOD medical expense and performance report should be available in the underlying documents such as the statistics matrix, the step-down schedule and final purification report. In addition, the information contained in the reports should represent totals for a reporting period rather than a statistical sample. It is suggested that better guidelines be published as to the format for presenting the data. For example, guidelines should specify whether data is to be recorded in whole hours, tenths of an hour or some other unit. In addition, guidelines should specify that amount recorded should represent the total for the period and not a statistical value.

Fourth, there is a need to publish some sort of results from the UCA. It is not necessary and certainly not advisable that raw data be published. However, it could be useful to an activity to have summary information available in order to develop a picture of where the activity stands in relation to others. Information which may prove helpful includes:

1. Descriptive statistics such as the average (mean) cost per unit of performance, the standard deviation, the number of activities which comprise the data, the range, the high and low values, and the percentage of total activity and total medical cost for the functional categories, and summary account level. Figures for both the service and DOD should be included.

2. The upper 75th percentile level or other level which could serve as an indication to activities that perhaps their costs are excessive.

3. The overall equivalent occupied bed day conversion rate for the service and for DOD overall.

Fifth, the cost performance relationships which have been analyzed in this thesis appear to warrant continued investigation as possible bases on which to make comparisons between the activities and the services. However, the principle value of the measures may be as screening mechanisms to identify those activities which warrant attention.

Finally, the weaknesses of whatever performance measure is used should be recognized. The user must be aware of the

incentives which the measure creates and insure that the incentives are desirable. Since an "appearance" of improved performance may sometimes be attained through manipulation of the performance measure, methods should be developed which discourage manipulation of the measure or will detect manipulation of the measure. It is suggested that a review of the performance measures to be used with the uniform chart of accounts be conducted and the incentives which they create identified. It is further suggested that methods be developed which discourage and/or detect unfavorable manipulation of the performance measures.

The recommendations may be summarized as follows:

1. Identify comparisons to be made -- with the civilian community, for instance -- and design the system to provide the data necessary.

2. Establish "peer group" categories for medical activities, preferably across service lines.

3. Provide specific guidelines for recording data in the UCA accounts.

4. Publish summary statistics to enable the activity to determine where it stands in relation to the others.

5. Continue evaluation of the four cost-relationship categories presented in this thesis.

6. Establish methods for discouraging or detecting possible unfavorable manipulation of the performance measures to be used with the uniform chart of accounts.

APPENDIX A

Description of the Uniform Chart of Accounts

This description of the uniform chart of accounts (UCA) will admittedly be brief. The intent is not to make the reader thoroughly versed in the UCA. Rather, this explanation is intended to provide a foundation for those unfamiliar with the UCA in order that an understanding of the analysis methodology contained in the thesis might be facilitated. The information contained within this appendix has been extracted from the test draft, Uniform Chart of Accounts for Military Medical Treatment Facilities.

The uniform chart of accounts (UCA) is composed of five chapters with each chapter, other than chapter one, representing integral elements of the uniform reporting system. The chapters are titled as follows:

Chapter 1 - Introduction

Chapter 2 - Definitional Terminology

Chapter 3 - Uniform Chart of Accounts

Chapter 4 - Cost Assignment Methodology

Chapter 5 - Reporting Requirements

A. Chapter 1 provides a brief presentation of the purpose of the UCA as well as an explanation of the organization of the remaining chapters.

B. Chapter 2 begins the process of orienting users of the UCA to a common language. This is a necessary prerequisite to implementing a standardized information reporting system into medical facilities representing three services with differing terminologies, accounting methodologies and administrative characteristics. Definitional terminology has been developed and categorized into five general areas.

Accounting Terminology

Facilities and Equipment Terminology

Patient Care Terminology

Standard Units of Measurement

Other Definitions (A Miscellaneous Category)

Chapters 3, 4 and 5 have the greatest implications from the standpoint of this thesis and will therefore be discussed in depth.

C. Chapter 3 contains the UCA which will be applicable to all fixed medical treatment facilities upon its implementation. The chart of accounts has been constructed in a hierarchial arrangement with major functional categories representing the broadest classification and subaccounts representing the third and smallest breakdown of costs. The general structure of this hierarchy as well as the account format will be briefly described. This will be followed with a more indepth analysis of the major components of the chart of accounts.

1. Hierarchy Description

As mentioned, functional categories represent the broadest category for aggregating costs and appear highest on the accounting hierarchy. There are six functional categories which are divided into a varying number of summary accounts. The summary accounts represent the second level in the hierarchy. The third and lowest level of the chart of accounts contains the subaccounts which are divisions of the summary accounts. An example of this hierarchy appears:

Level I Inpatient Care (Functional Category)

Level II Medical Care (Summary Account)

Level III Internal Medicine (Subaccount)

Cardiology (Subaccount)

Next Level II Surgical Care (Summary Account)

Level I Ancillary Services (Functional Account)

Level II Pathology (Summary Account)

Level III Clinical Pathology (Subaccount)

Blood Bank (Subaccount)

There are four elements which are generally common to each UCA account regardless of the level of the hierarchy. The first element is termed "function." The function contains a description of the type of activity characteristic of the particular account. For example, the type of services provided, administrative duties performed and usual training performed would be included. The second element is entitled "costs." This element identifies the expenses which shall be

included in the account. "Performance factor" is the third element of the account. The performance factor identifies the uniform workload measure which is to be collected and used for evaluating or gauging performance. The final element is "assignment procedure." This element establishes the basis under which the account cost will be reassigned if applicable. The assignment methodology will be presented during the discussion of Chapter 4.

An understanding of the structure of the chart of accounts facilitates a sufficient understanding of the type of analysis which might be done as well as the reasons for doing so. Therefore, a more indepth analysis of the structure of the UCA is deemed necessary.

2. Level I Description

There are six functional categories into which the activities total costs may be classified:

Inpatient Care

Ambulatory Care

Dental Care

Ancillary Services

Support Services

Special Programs

Inpatient care is defined as that care which provides for the examination, diagnosis, treatment and proper disposition of inpatients. The inpatient care functional category is a summarizing account which accumulates all the operating

expenses for all the inpatient care accounts and represents the total cost of inpatient care procedures.

Ambulatory care provides for the care, consultation, examination, diagnosis, treatment and disposition of both inpatients and outpatients which are treated by the various ambulatory care clinics. The ambulatory care functional category provides for the collection of operating expenses related to primary or emergency medical care, diagnostic services, minor surgical procedures, medical examinations, immunizations, consultation and disposition of both inpatients and outpatients seen in accordance with the ambulatory care definition. This is a summarizing account which represents the total costs of ambulatory care for the activity.

The dental care functional category includes comprehensive dental care for active duty, as well as retired and dependents on certain occasions. The dental care functional account includes all the operating expenses incurred in operating and maintaining the dental center, dental clinic or prosthetic laboratory.

Ancillary services are defined as those services that participate in the care of patients by assisting and augmenting the physicians and dentists in diagnosing and treating human ills. The ancillary services generally do not have primary responsibility for the patient, but provide patient services upon the orders of the cognizant provider. Examples of ancillary service include the laboratory, pharmacy and radiology services.

This also is a summarizing account which accumulates all operating expenses for the ancillary services.

Support services are those services which are necessary to direct and support the mission of the medical facility. Support services perform the managerial and administrative functions for the activities. This functional account summarizes the operating expenses for all the support services and includes depreciation for the activity. The account total represents the total support costs for the facility.

The final functional category -- special programs -- represents those activities which are performed as a result of responding to its military mission rather than to direct patient care. The special programs account is a summary of all major operating expenses and represents the non-patient care costs of the activity.

It is important to note that the inpatient care, ambulatory care, dental care and special programs accounts are "final operating expense accounts" while ancillary services and support services accounts are "intermediate operating expense accounts." A final operating expense account is the final expense accumulation point in the system. The expenses contained in an "intermediate operating expense account" are allocated to final operating expense accounts and are therefore temporary accounts.

3. Level II Description

The second level in the account hierarchy contains the summary accounts which serve as a midlevel collection point for the cost data. The summary accounts generally coincide with the services which are either provided or performed by the medical facility.

The number of summary accounts within a functional category presently varies from one under dental care to twelve under the ambulatory care functional category. (Beginning with fiscal year 1979, this was reduced to eleven by combining EENT care with surgical care.) The summary accounts under inpatient care, ambulatory care, dental care and ancillary services are generally self explanatory and therefore will not be individually discussed. The functional categories of support services and special programs, however, contain summary accounts which may not provide a clear indication of the services provided. These summary accounts will be briefly described, as appropriate.

Each of the functional categories and the respective summary accounts are presented below to provide an indication of the scope of the functional area as well as to orient the reader to the type of services provided under each functional area.

Inpatient Care

Medical Care
Surgical Care
OB/GYN Care
EENT Care
Pediatric Care
Orthopedic Care
Psychiatric Care

Ambulatory Care

- Medical Care
- Surgical Care
- OB/GYN Care
- Pediatric Care
- Orthopedic Care
- Psychiatric/Mental Health Care
- EENT Care
- Family Practice Care
- Primary Medical Care
- Emergency Medical Care
- Flight Medicine Care
- Underseas Medicine Care

Dental Care

- Dental Care

Ancillary Services

- Pharmacy
- Pathology
- Radiology
- Special Procedures Services
- Surgical Services
- Central Sterile Supply/ Material Services
- Same Day Services
- Rehabilitation Services
- Nuclear Medicine

Support Services

- Depreciation
- Personnel Support Services
- Material Service
- Biomedical Equipment Repair
- Inpatient Food Service
- Inpatient Affairs
- Command and Admin Support Services
- Public Works
- Housekeeping and Janitorial Service
- Linen and Laundry Service
- Ambulatory Care Administration

Special Programs

- Specified Health Related Programs
- Military Unique Medical Activities
- Public Health Services
- Health Care Services Support

The command and administrative support category under support services contains a variety of services. While the titles may differ between the three services, the functions included in the category are essentially the same. A list of functions applicable to the Navy is as follows:

The Office of the Commanding Officer

Chief Nurse and Staff Support

Portions of the Operating Management Service

Communications

Religious Activities Service

Legal Service

Civilian Personnel Service

Fiscal/Comptroller Service

Disbursing Service

Data Processing Service

Naval Exchange Service Outlets for Patients

American Red Cross Field Director

The summary account personnel support services was designed primarily to handle autonomous naval medical facilities in which the Commanding Officer is also responsible for base support services of which only a small portion of the total expense is applicable to patient support. The portion which is for patient support is an appropriate charge to this account. Examples of functions which are applicable are as follows:

Police Protection

Fire Protection

Special and Recreational Services

The ambulatory care administration summary account is a collection account for a variety of clerical functions related to outpatients and outpatient records. Examples of

functions which are appropriate to be included in this account include the following:

Health Benefits Information Program

Centralized Appointment Services

Outpatient Records Service

Champus Counseling

Most of the summary accounts in the functional category special programs contain services which are obviously not directly related to health care. The distinction may not be clear in all instances, particularly in the area of health care services support. Therefore the functions applicable to this account are presented below:

Health Care Services (Summary Account)

Supplementary care purchased from civilian sources

Military and civilian guest lecturer and consultant program

Support to other military activities

Support to other federal agencies

Champus beneficiary support

4. Level III Description

Subaccounts are the lowest level of the chart of accounts hierarchy. As a general rule, subaccounts are identifiable performance units. For example, the summary account medical care may contain subaccounts for internal medicine, cardiology, dermatology and others. The summary account pathology may contain subaccounts for clinical pathology, anatomical pathology and blood bank. It is at the

subaccount level that the UCA is most versatile and the level at which the activity manager has the most latitude and flexibility. The manager can establish accounts in any manner which satisfies the activity's internal needs provided that the cost data will be "stepped back" to the proper summary account during the reassignment and summarizing process. An example of when this versatility could be helpful is in the case in which an activity performs the same function at more than one location. The system is flexible enough to allow the accumulation of expenses for each location rather than as a combined total. Thus, the managers can monitor the behavior of the units and investigate when variations in performance occur.

An additional feature of the subaccount level is the capability for establishing what are termed "pooled accounts." The usefulness of this feature can be noted in instances in which an activity has several functions operating out of the same location. For example, a facility may have a combined ward with OB/GYN, surgical and orthopedic patients. Any attempt to identify the originator for each and every expense would be immensely time consuming, if it could be accomplished at all. As an alternative, all expenses for the ward are accumulated in one account (a pooled account). During the summarization process the pooled account would be allocated to the proper summary account.

D. Chapter 4 is entitled "cost assignment methodology." The full cost of a responsibility center should be the sum of its direct costs plus an equitable share of the facility's indirect costs. Anthony and Herzlinger state that the allocation of indirect costs should be conducted "...according to either of two criteria: (1) In proportion to the benefits received by the cost objectives, or (2) in proportion to the extent that each cost objective caused the cost to be incurred" [6]. The UCA conforms to both of these methodologies for allocating indirect costs. The purpose of Chapter 4 is to promulgate a cost assignment method by which the expenses incurred for support services and ancillary services can be assigned to the final operating expense accounts of the inpatient, ambulatory, dental and special program functional categories.

The cost assignment methodology contains five steps which will be briefly described and is depicted in Fig. 6.

Step 1: Non-personnel direct expenses and performance data are assigned to the respective intermediate and final operating expense accounts.

Step 2: Full-time equivalent man-months and salary expenses are distributed to the intermediate and final operating expenses.[1]

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[1]The accumulation of personnel full-time equivalent man-months was not a capability which existed in fiscal year 1978 -- the period for which the data for this thesis relates.

Step 3: A pre-step-down purification of expenses is conducted. In some instances, expenses should be allocated to other accounts but overhead expenses should not be included. This step of the cost assignment methodology allows such an allocation. This step may be used, for example, if parts utilized by biomedical equipment repair were not directly charged to the user of the medical equipment by material services.

Step 4: Expenses of the intermediate operating expense accounts and cost pools are assigned through a step-down process to the final operating expense accounts. This is represented pictorially in Fig. 6.

Step 5: Finally, a post-step-down purification of the final operating expense accounts are pro-rated to another account based on a performance factor or unit of service. For example, inpatient or ambulatory care expenses may be appropriately charged to special program accounts such as the alcohol and drug abuse/rehabilitation program. Workload totals are also reduced accordingly.

E. Chapter 5 of the UCA is entitled "reporting requirements." "The DOD Medical Expense and Performance Report" is the only report presently required from UCA users. The report consists of five sections. Part 1 contains cost and performance data for direct patient care. Part 2 contains cost and performance data for the ancillary services. Cost data are presented for the support services in Part 3 and special programs in Part 4.

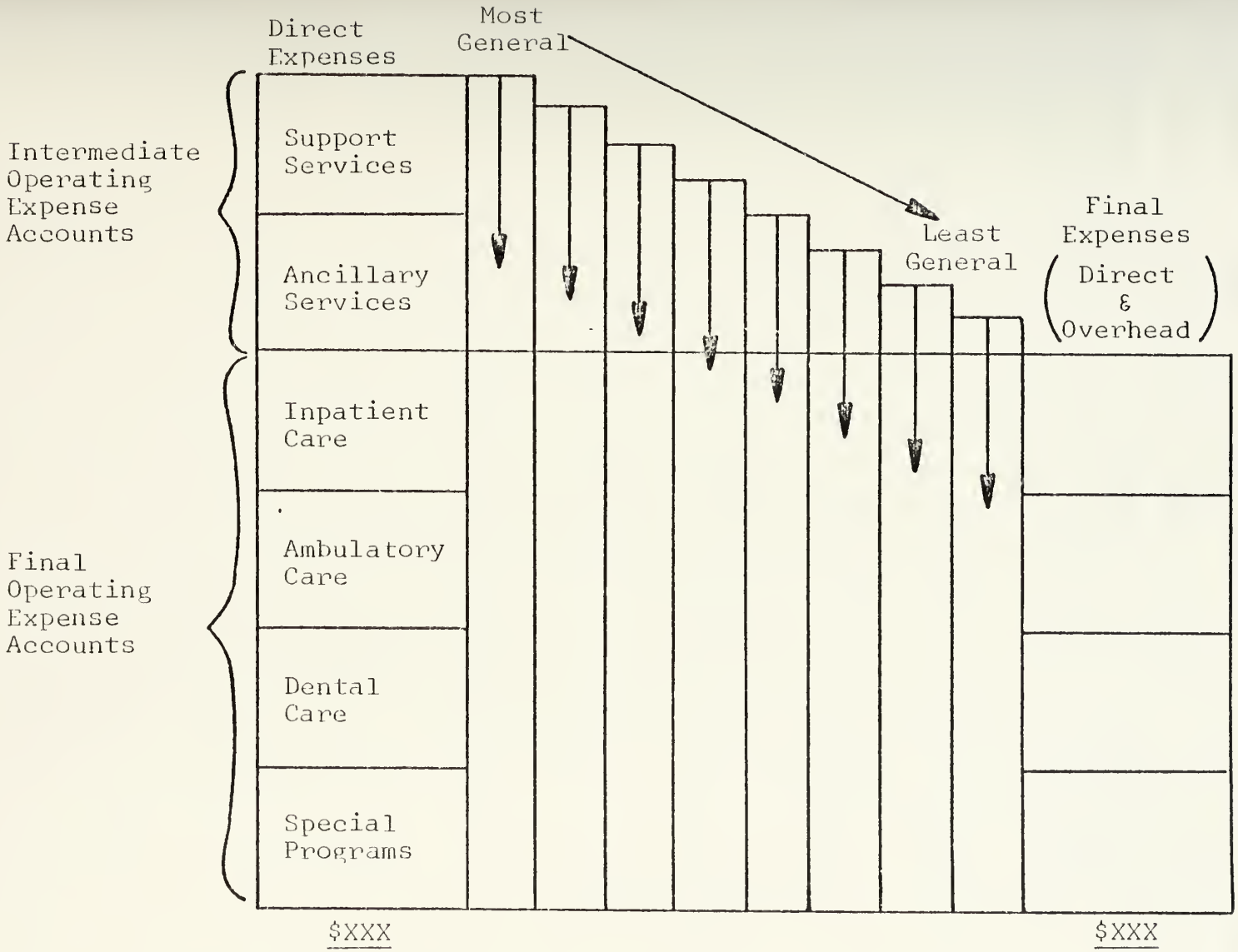

Figure 6

Diagram of Overhead Assignment Process

Finally, a narrative section is contained in Part 5 to enable activities to make applicable comments concerning the report.

As stated initially, this description of the UCA is admittedly brief. It is hoped that this explanation will provide a foundation for those unfamiliar with the UCA.

APPENDIX B

Research Methodology

Research into the background, operation and potential of the DOD uniform chart of accounts was an involved and complex undertaking. The purpose of this appendix is to present in greater detail significant aspects of the research and analysis process which the author followed. This appendix will be presented in three sections. In the first section, the service perspective of the uniform chart of accounts will be discussed. The views of the originators and users with respect to the potential value of the UCA and particularly their fears will be presented. In the second section, a description of analyses performed by two current users of a uniform accounting system -- California and Washington -- will be presented. In addition, a discussion of the review of the literature conducted by the author will be undertaken. In the final section, a more indepth presentation of the analyses methodology such as screening methods used and statistical analysis performed -- specifically the nested design -- will be undertaken.

A. SERVICE PERSPECTIVE

The factors which motivated the development of the Uniform Chart of Accounts for Military Medical Treatment Facilities were discussed in Chapter I. Initial efforts of

the research were directed toward developing an understanding of the concepts on which the UCA was developed, as well as determining the direction the developers of the UCA planned or anticipated. Each of the three service project managers were interviewed with respect to these two broad objectives.

1. Designers Perspective

The UCA was not developed to respond to a particular analysis methodology. Output requirements had not been identified or specified prior to the design of the UCA. It was felt that a more important objective was the design of a system which would produce comparable data from activities of three services with vastly different information and accounting systems. To design a system to respond to only the data requirements at that time was viewed as limiting the system. In contrast, a major thrust of the designers was to develop a system which would provide information for whatever analysis the job of the day dictates. It is felt that a system is much better if it can respond to individual inquiries.

The designers felt that the UCA had tremendous capabilities. It is envisioned that the UCA will eventually be used to make decisions such as whether it is more cost effective to perform a function at a particular hospital or send patients to the civilian community. Also, decisions can be made whether to perform various services at hospital "A" or hospital "B" or even to shut down a particular hospital. While it may be some time before decisions of this type are

made based on UCA data, it is almost certain that comparisons will be made between hospitals, between services and with the civilian community. The designers are convinced that the DOD UCA is compatible with civilian methods and therefore equivalent comparisons should be able to be made. At the very least, it is expected that the UCA will enable better decisions of the type presently being made. Although the developers were certain comparisons would be made, they were not sure of the nature of the comparisons nor how they would be accomplished. At the time of this research procedures for analyzing the data had not been developed or anticipated.

2. Users Perspective

Each of the UCA test site project coordinators were queried with respect to the present and anticipated use of the UCA at the activity level. A great deal of enthusiasm was expressed by the activity project officers for the UCA. While there was some lack of cooperation within the activity, resistance was lessening and interest growing. Much of the interest was a result of department personnel becoming aware for the first time of the total cost of operating their department. Despite the interest shown by some members at the activities, support for the UCA could not be called overwhelming. While personnel complied with the requirements of the UCA, most were not interested in the information which could be provided.

The activity project coordinators were generally unsure of the direction analysis of the UCA data would take.

Most of the activities were attempting to perform some type of data analysis, but it was generally an uncoordinated effort. Much of the analysis was directed internally although the activities were provided the DOD Medical Expense and Performance Report (MEPR) of the other activities for comparative purposes. The MEPRs will reportedly not be distributed among the activities once the UCA is implemented world-wide. Therefore, the analysis at the activity level will have to be limited to internal analysis and comparisons with information provided by higher authority. All expressed concern about the prospect of being compared with other activities since the nature of the comparisons are unknown. There is a general uneasiness about the possibility of inappropriate use of the data or of drawing inaccurate conclusions. Many expressed concern that decisions which would impact heavily upon the activity would be based on inappropriate comparisons. Some felt that the UCA alone did not give sufficient emphasis to the unique features of an activity. Some questioned the capability for making comparisons between activities since the data from some activities included branch hospitals or branch clinics while others only had a central facility. This "comparability" may be even more of a concern as attempts are made to make comparisons with the civilian community.

B. CURRENT PRACTICE

While the issues of performance, comparability and uniformity of military medical facilities are not new ones, it is only in recent years that they have received real emphasis. In contrast, these are all issues which have received a great deal of attention for many years in the civilian community. Of principle interest are the type of analyses currently being done by agencies responsible for supervising a uniform accounting system and the type of comparisons and/or analyses found in a search of the literature.

1. Current Users

Several states have enacted legislation requiring the implementation of uniform accounting systems. The agencies responsible for the operation of the uniform accounting systems of two states -- California and Washington -- were contacted in order to obtain an idea of the current analyses practices. It should be noted that the systems of both states contain the full range of accounts; asset, liability, capital, income and expense.

The uniform accounting system for the state of California was adopted in 1973. Analysis of the data which is reported to the California Health Facilities Commission has been predominently directed at comparisons of various financial ratios of the following nature: liquidity and working capital ratios, debt risk and leverage ratios, equity and asset utilization ratios, profitability and return ratios,

labor ratios and direct operating expense ratios. Some statistical analyses of costs per unit are completed to identify activities above the 75th percentile and below the 25th percentile. While nothing has been published, analyses of the data have also been directed at identifying the characteristics of high cost and low cost facilities and in trying to identify the incentive structure of the hospital community. While some consideration is given to the specific characteristics of each facility, grouping of the facilities is limited to that of size and ownership.

A state-wide health planning program and certificate of need program was established in the state of Washington in 1973. Included as part of the health planning program was a uniform accounting system and a uniform budgeting and rate-setting program. The analysis conducted by the Washington State Hospital Commission appears limited to the two step budget review process. In the process hospitals are subjected to primary and secondary screening. The primary screens consist of eighteen expense screens and the secondary screens consist of sixty-seven screens. The primary screens review four areas generally with respect to the four measures of (1) cost per adjusted admission, (2) cost per adjusted admission as a percent change, (3) cost per adjusted patient day and (4) cost per adjusted patient day as a percent change. The four areas reviewed are total cost, daily hospital services, ancillary services and growth and development. The secondary

screens review daily hospital services, ancillary services, support services and growth and development in greater detail. Each of these areas are screened with respect to the four measures of (1) cost per performance measure as a percent change, (2) cost per performance measure, (3) number of performance units per case, (4) total expenses per full-time equivalent manpower (FTE), and (5) number of performance units per FTE. The secondary screening involves two screens for each area which measure input prices and productivity and two screens which measure intensity and costs. A hospital passes the primary screens if it is equal to or below the 50th percentile of its peer group and the secondary screens if it is equal to or below the 70th percentile of its peer group. The problem with using a percentile in this manner -- to identify only those hospitals which will be reviewed -- is that it implicitly assumes that hospitals operating below the 70th or 50th percentile are operating economically. Since only the hospitals which are above the 70th percentile are secondarily reviewed, hospitals have a subtle incentive to increase costs up to the 70th percentile. Of course, the more hospitals which seek to increase costs up to the limit, the higher will be the 70th percentile.

One very impressive aspect of the development of the Washington hospital planning program is the emphasis placed on the development of a system for classifying or grouping hospitals. A number of factors interact and influence the

operation of a hospital. Examples of variables which were identified as important include the number of beds, location, population served, mix of physician specialities, average income of area served and several others. These variables were categorized as exogenous (those factors generally outside the control of the hospital) and endogenous (those factors which are somewhat controllable by the hospital). Once the variables had been identified for each hospital, a cluster analysis technique was utilized to group hospitals into "peer groups." Hospitals are then evaluated with respect to the members of its "peer group."

2. Literature Review

A wide variety of cost and performance evaluation methodologies prevail in the literature. It is not the intent of the author to discuss all the articles reviewed, but to present a few examples of the evaluation techniques found in the literature to demonstrate the data requirements characteristic of the methodologies in existence.

Ruchlin and Leveson, in two studies [14,24], present methodologies for measuring hospital output and estimating hospital productivity. Hospitals are composed of an output and an input component which are calculated by summing the index values of each element composing the input or output component. The indexes are weighted values based on the average "value" of the element for all hospitals. An overall

index of productivity is obtained by dividing the output index by the input index.

$$P = \frac{\text{Output Index}}{\text{Input Index}}$$

Data which must be available to use this methodology include the cost of labor, supplies, plant and equipment, clinic and ER visits, home care, case mix heterogenity and education activities, to name a few.

Grimes and Moseley [25] developed two indexes based on 30 measures of administrative and patient care effectiveness as gleaned from the literature and a delphi panel. Each index was calculated by summing the product of a weighted measure times the hospital standardized score for the measure.

I = Sum of (weighted measure X hospital score on measure) for all measures

Data which are necessary to use this measure include the percent of surgically removed tissues which prove to be normal, a rating of other hospitals of the activities patient care performance, patient dissatisfaction, autopsy rate, average length of stay and others for the patient care index. The data required to use the management index include the extent of hospital research into 18 management problem areas, cost per unit of output in four areas, accreditation, employee dissatisfaction, nursing hours per day and several others.

Many other examples exist of various methodologies for examining or comparing the performance of medical facilities. Other examples of the data required by various evaluation techniques include:

Total and direct medical care costs

Hospital size

Number of services provided

Number of student nurses

Numbers of different types of intern and residency programs

Average wage rate

Population served

Staffing levels

Deflated non-wage costs per patient day

Service mix

Occupancy rate and many others

It is recognized that a system which could respond to the many and varied data demands of the methodologies available in the literature would be extremely complex and expensive. None the less, certain techniques are dominant in the literature such as the various analyses conducted by the American Hospital Association and published in Hospital Statistics [15]. Data requirements of several of the more valuable methodologies should be identified. The uniform chart of accounts should then be developed to provide the necessary data.

C. STATISTICAL METHODS

The uniform chart of accounts generates a great deal of data. In the initial attempt to "make some sense" out of the data, several screening methods were found helpful. The purpose of this section is to briefly describe two of the methods which proved helpful to the author. This will be presented in Part 1. Part 2 will present a further description of the nested design. Since justification for the nested design has been presented in Chapter III, this section will concentrate on the unusual arrangement of data which was necessary and the computational aspects of the analyses.

1. Screening Methods

The Statistical Package for the Social Sciences (SPSS) was used extensively to screen the UCA data. Two programs which were the most useful were the "scattergram" and the "condescriptive" routines.

The "scattergram" was useful for obtaining a "picture" of the data. The position of one hospital in relation to the others was easily visualized. Particularly useful was observing the positioning of activities by size and service. It was interesting to note whether the behavior of a facility was typical for a small, medium or a large hospital. The reaction of various dependent variables to independent variables could be analyzed. The scattergram provides basic statistical information such as the Pearson's R, R squared, significance of R, the standard error of the estimate, the intercept with the vertical axis and the slope.

The "condescriptive" routine was useful for obtaining basic descriptive statistical information on the various variables. The statistics which are available include the following:

Minimum, maximum and range values

Mode

Median

Mean

Variance

Standard deviation

Standard error of the mean

Skewness

Kurtosis

When the scattergram and condescriptive were used in conjunction, a useful picture of the data was obtained.

Several useful methods for analyzing data are contained in the SPSS. It is not the author's intent to minimize the value of the other methodologies, but to identify the screening methods used by the author during the research. Further, should higher authority decide to provide some form of descriptive statistics to the activities in order that they might obtain a feel for where they stand in relation to others, the condescriptive routine could provide much of the data which would be desirable.

2. Nested Design

The rationale for using the nested design for the analysis of variance was presented in Chapter III. The distribution of activities included in the UCA test required the data to have to be arranged in an unusual manner. In addition, the nested design may be unfamiliar to some readers. Therefore, it appears appropriate to provide a more indepth explanation of the data arrangement and the computational methodology [20,21,22].

a. Data Arrangement

It may be recalled that two factors -- size and service -- were selected on which to make comparisons. This classification resulted in one small and one medium Air Force facility, one small, one medium and one large Army facility and two small Navy facilities plus one medium and one large facility. Two observations were available for each facility. This resulted in four observations for the Air Force category, six for the Army and eight for the Navy category. This arrangement is portrayed in Fig. 2 of Chapter III and will be demonstrated below. While this unbalanced arrangement necessitated that computations be performed manually, it was believed that the arrangement would not adversely affect the statistical results. The first step in preparing the data for analysis is to construct a table with three major service categories. Under each service are three columns, one for each size medical facility. Each of the size

columns are totaled and a total for each service is obtained. Second, a grand total for the entire table is obtained. Finally, each observation is squared and then summed to obtain the "sum of the squared observations." The data arrangement will be demonstrated through the use of an example.

	AIR FORCE			ARMY			NAVY		
	S	M	L	S	M	L	S	M	L
QTR 1	120	120		232	152	133	216 290	176	143
QTR 2	180	111		186	137	110	169 178	174	174
SIZE TOTAL	300	231		418	289	243	853	350	317
SER TOTAL		531			950			1520	
GRAND TOTAL					3001				

b. Computations

After the data have been arranged as noted above, the computations necessary to obtain an F ratio are completed. The formulas for the general case of the nested anova will be presented first. This will be followed by the computations for the above example using the methodology followed by the author.

(1) Sum of squares - service

$$\sum_{i}^{a} \frac{T_{i..}^2}{nb} - \frac{T_{...}^2}{nab}$$

(2) Sum of squares - size within service

$$\sum_{i}^{a}\sum_{j}^{b}\frac{T_{ij.}^{2}}{n} - \sum_{i}^{a}\frac{T_{i..}^{2}}{nb}$$

(3) Sum of squares - error term or variation within the sizes

$$\sum_{i}^{a}\sum_{j}^{b}\sum_{k}^{n} Y_{ijk}^{2} - \sum_{i}^{a}\sum_{j}^{b}\frac{T_{ij.}^{2}}{n}$$

(4) Sum of squares - total

$$\sum_{i}^{a}\sum_{j}^{b}\sum_{k}^{n} Y_{ijk}^{2} - \frac{T_{...}^{2}}{nab}$$

where a = number of service categories

b = number of size within service categories

i = observations in the service category

j = observations in the size category

k = observations in an ij cell

n = number of observations for the category, i.e.,

na = number of observations in the "a" category

The dot notation indicates the summing of all observations in the particular population. For example, the formula for computing the sum of squares - service may be read as follows:

(1) First Part of the Formula. Sum the amounts in each size column of the table. Next sum the totals of the size columns for each service and square this total. Divide this last amount by the total number of observations in each service category. This computation provides:

$$\sum_{i}^{a} \frac{T_{i..}^2}{nb}$$

(2) Second Part of the Formula. Sum the amounts in each column of the table. Next sum the totals of the size columns for each service as was done above. Then sum the amounts for each service to obtain a grand total and square the grand total. Finally, divide this amount by the total number of observations in the table. This provides:

$$\frac{T_{...}^2}{nab}$$

The sum of squares - service is then obtained by subtracting the second amount from the first.

The computations of the sum of squares values during the analysis of the UCA data was accomplished by a slightly different, but mathematically equivalent process. The method used required less difficult computations since some values are obtained through subtraction rather than direct computations. The fault of this method is that an error in one figure will cause an error in the second. In view of the number of computations which were viewed necessary, the limited time available and the low value of an incorrect computation, the short cut was felt to be appropriate. A demonstration of the methodology used is as follows:

(1) Sum of squares - service. This is similar to the method for the general case.

$$\frac{(531)^2}{4} + \frac{(950)^2}{6} + \frac{(1520)^2}{8} - \frac{(3001)^2}{18} = 9374$$

(2) Sum of squares - size within service. First, the sum of squares for all sizes is obtained. Each size column is totaled and divided by the number of observations in the column.

$$\frac{(300)^2}{2} + \frac{(231)^2}{2} + \ldots + \frac{(853)^2}{4} - \frac{(3001)^2}{18} = 23,391$$

Then the SS (service) is subtracted from the above SS (sizes) to obtain the SS (size within service) amount.

$$23,391 - 9,374 = 14,017$$

(3) Sum of squares - total. This figure is obtained in the same manner as described for the general case. Each observation is squared and then a sum obtained. Subtracted from this amount is the sum of the observations squared and divided by the total number of observations.

$$536,581 - \frac{(3001)^2}{18} = 36,248$$

(4) Sum of squares - error. This figure is obtained by subtracting SS (sizes) from SS (total).

$$36,248 - 23,391 = 12,857$$

These figures are then placed in the general format for computing an F ratio presented in Fig. 3 of Chapter III.

Source of Variation	D.F.	SS	MS	F
Between Sizes	7	23391		
Service	2	9374	4687	3.65
Size/Service	5	14017	2803	2.18
Within Sizes	10			
Error	10	12857	1285	
TOTAL	17	36248		

The computed F statistic of 3.65 for the service category is compared with a F table with degrees of freedom (2,10). This value is less than the table value at the 95% level of significance. Therefore, the null hypothesis of no difference between the services cannot be rejected at the 95% level. In the same manner, the computed F statistic of 2.18 for the size within service category is compared with the F table at (5,10) degrees of freedom. This value is less than the table value at the 75% level of significance. Therefore, the null hypothesis of no difference between the variations within the services cannot be rejected at the 75% level. Significance levels of 75% and 95% are used in an effort to provide clarity to those unfamiliar with statistics. The normal practice in statistics is to use an "alpha level" of 25% and 5% respectively.

All computations of the F statistic were accomplished in the manner which has been described. As a final point, it should be noted that the data was assumed to be of a

fixed design. Therefore, the error term is the denominator in both F ratio computations. If the design is of a random or mixed nature, a determination of the denominator is necessary. The reader is invited to review Duncan, Hicks and Winer [20,21,22] for a more thorough description of the nested design of the analysis of variance.

APPENDIX C

Relationship of the DOD Uniform Chart of Accounts to a Financial and a Theoretical Cost Accounting System

The uniform chart of accounts is a new and unique experience for members of the military medical community. The title "Uniform Chart of Accounts" may stimulate visions of a financial accounting system consisting of debits, credits, income statements, balance sheets and a chart or schedule listing the asset, liability, capital, income and expense accounts. In this regard, the uniform chart of accounts may cause some misconceptions. The Uniform Chart of Accounts for Military Medical Treatment Facilities was not devised as a system for capturing medical expenses and workload data uniformly among the three services and reporting these expenses to higher authority. The system may more appropriately be titled a "Uniform Expense Collection and Reporting System."

Since some readers may not be familiar with either the Uniform Chart of Accounts for Military Medical Treatment Facilities (UCA) or the financial accounting system of the military, it may be appropriate to place the uniform chart of accounts in perspective. This chapter will discuss the relationship between the uniform chart of accounts and the financial accounting system of the Navy. The operation of the UCA will be briefly described and the relationship between it and a financial accounting system will be discussed in Section A.

Many features of the UCA approximate or have parallels with a cost accounting system. Section B will analyze the features of a theoretical cost accounting system and compare the UCA with a theoretical model.

A. THE UNIFORM CHART OF ACCOUNTS AND THE FINANCIAL ACCOUNTING SYSTEM

Financial accounting is in the mainstream of most all organizations. It is through the financial accounting system that income, expenditures, profit, loss, purchases, sales and many other aspects of the organizations operation are recorded. The financial accounting system is the means by which an organization keeps track of its assets, liabilities, capital, income and expenses. The UCA was not designed to replace the financial accounting system of the medical facility. The UCA was designed to operate in addition to the existing accounting system. It should be noted that the UCA only collects and reports expenses. The accounting categories of assets, liabilities, capital and income are not contained in the Uniform Chart of Accounts for Military Medical Treatment Facilities. This characteristic distinguishes it from other existing "uniform accounting systems." A general description of the Uniform Chart of Accounts for Military Medical Treatment Facilities will be briefly presented[2] and its relationship to a financial accounting system described.

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[2]A more detailed description of the UCA is presented in Appendix A.

A Navy accounting system will be described since it is the one with which the author is most familiar.

The uniform chart of accounts contains accounts of two distinct cost accounting natures. One group is "service" oriented and is identified as "support services" in the UCA. These accounts are used to gather expenses for those functions which support the delivery of health care, but which do not have a direct role. There are eleven major service accounts (termed summary accounts) under the support service functional category. Although the accounts often coincide with organizational divisions, they actually represent functions performed. Each of the support service accounts accumulates the direct expenses it incurs in supporting the mission of the medical facility. The sum of the expenses of the eleven support service summary accounts represents the overhead of the activity.

The second group of accounts represents those functions which are directly involved in the provision of health care. These accounts are "production" oriented accounts in the cost accounting sense. There are four major functional categories which are included in the "production" account classification. The categories are inpatient care, ambulatory care, dental care and ancillary services.

The UCA contains one additional functional category account identified as "special programs." The special program accounts were established to collect the expenses for those functions

which are incurred as a result of the activity performing its military mission other than direct patient care.

In addition to the "support service," "production" and "special programs" accounts, the UCA contains a methodology for the distribution of the "special programs" accounts. This is analogous to the distribution of overhead in the cost accounting sense. The UCA also promulgates standardized reporting requirements.

The UCA does not contain nor specify a system for collecting expense data. The UCA specifies that certain expenses or workload data are to be included in each of the accounts. Each service and/or activity is permitted the flexibility of determining the method to be used to collect expenses for each of the accounts. For example, the UCA may specify that all direct expenses for the operation of the surgical clinic and the number of visits be included in the surgical clinic sub-account. While it indicates what information will be obtained in the account, it does not instruct the activity on how it will obtain the data. In this regard, the UCA is not an entity unto itself, but is dependent upon each activity developing a methodology for the capture of the required expenses.

In order to understand the operation of the UCA, the reader should have an appreciation for the relationship between the UCA and the financial accounting system found in military medical facilities. This relationship will be developed through the use of a model depicting the financial accounting system as

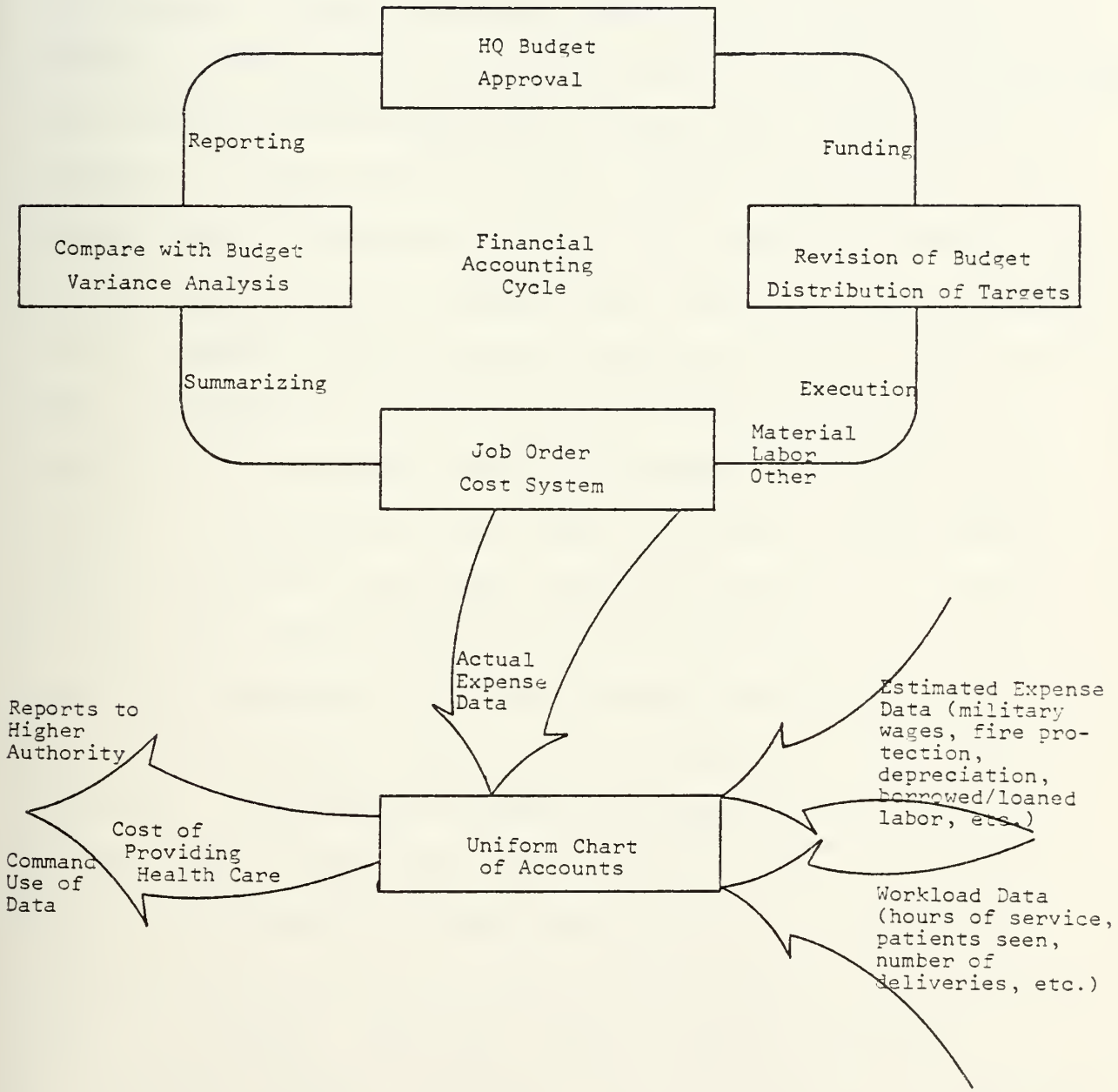
a cycle. The model will be developed in broad general terms rather than of a specific activity.

The model, shown in Fig. 7, begins with the approval of a level of funding for the upcoming fiscal period based on previous submission of a budget or financial plan. The financial plan is revised to meet the present needs of the activity and target spending levels are distributed accordingly. During the execution period expenses are incurred and are routinely recorded by means of a job order system. Briefly, the job order system classifies expenses as to which unit is spending the funds, what they are being spent for, what type of resources are being consumed and what is the cost. Periodically, the job order accounts are summarized and are compared with the financial plan. Variances or deviations from the plan are investigated and dealt with as necessary. This is not true variance analysis in the cost accounting sense, since the expenses are not associated with a level of output. For example, did the doctor do a good job of managing his funds because he spent $100 less than his budget when he only saw half the patients he was budgeted to see?

It will be noted in Fig. 7 that the uniform chart of accounts does not fall within the financial account cycle. The significance of this is that expenses do not really flow through the UCA. Instead, expense information is extracted from the activities existing job order system. It will be noted also that, although actual expenses contained in the job

Figure 7

Relationship of UCA to Financial Accounting System



order system constitute the majority of the UCA financial data, the expenses for several functions are obtained from other sources and are often estimated expenses. The term estimated is used to distinguish between the concreteness of the job order expense data and the data from sources outside the job order system, however accurate they may be. The fact that the UCA for military activities is not part of the financial accounting system also distinguishes it from other uniform charts of accounts. It also may be the most serious defect of the DOD uniform chart of accounts and one which warrants further study.

In addition to the expense data, workload data is obtained for the summary accounts from a variety of sources. The particular performance or workload measure for each function is specified in the uniform chart of accounts. Measures include number of occupied bed days, number of visits, prescriptions filled (weighted), procedures completed and hours of service, to name a few. The workload data may be actual counts or statistical estimates. In the financial accounting system, many of the "service" costs are not allocated to the other functions. An internal information system may make such an attempt, but a formal Navy system does not exist and such a system is an exception rather than the rule. In contrast, a formal expense allocation system does not exist in the uniform chart of accounts. After the expense and workload data are gathered for the particular reporting period, a step-down procedure of the "service" accounts into the "production" and

"special programs" accounts is performed. All summary accounts are arranged in a matrix format in a specified order and then the expenses for each "service" account are distributed over the remaining accounts. This exercise is performed until all "service" accounts have been distributed and only the "production" and "special programs" accounts remain. The total contained in each of the accounts represents the direct expenses incurred in performing the function plus its share of the expenses incurred in the support of the function. Division of the total expenses by the workload unit generates a cost per patient day, per visit, or procedure. This information is used to satisfy reporting requirements and activity management needs.

Summarizing the analysis to this point, the uniform chart of accounts has been shown to be an "expense collection and reporting system" rather than a financial accounting system. It has been further shown that the uniform chart of accounts is not an independent system but is dependent upon several either new or existing systems for information. The relationship between the financial accounting cycle and the uniform chart of accounts has been demonstrated by means of a model. Finally, the operation of the UCA has been described.

B. THE UCA AND A THEORETICAL COST ACCOUNTING SYSTEM

It was previously indicated that although the UCA is not a financial accounting system, it appears relevant to compare

the UCA with a theoretical cost accounting system (TCAS). The analysis in this section will be directed toward investigating the hypothesis that the UCA contains features which warrant its consideration as a cost accounting system. In performing this analysis, the benefits of a theoretical cost accounting system will be discussed. Then, the features of the UCA will be compared with those of the theoretical model.

It is generally acknowledged that business operations, whether civilian or governmental, are becoming increasingly complex and difficult to control. If the manager is to respond to these increased demands and complexities, it is necessary that systematic, comparative cost information be available which will enable the manager to choose between alternative courses of action. In order to serve management, a cost accounting system should provide the data which will assist management to perform five basic functions [26].

First, the cost accounting system should provide the information necessary to facilitate preparation of budgets of materials, labor and overhead costs at varying volumes of activity.

Second, the cost accounting system should encourage cost control by means of responsibility accounting. In this regard, individuals should be assigned responsibility for those costs they incur to the extent they can control them. Performance should be reported periodically in order to facilitate control.

A cost accounting system should enable comparison or matching of expired costs with the revenues for the period. While governmental activities are not concerned with revenues per se, it is desirable to know which resources were consumed to produce a specific output.

A fourth feature a cost accounting system should contain is to assist in the establishment of selling prices. Although the services' medical facilities do not generate revenue, it is becoming increasingly necessary for activities, the services and DOD to show that military medicine can reasonably compete with the civilian community. A cost accounting system should provide governmental activities with this capability.

Finally, a cost accounting system should furnish managers with relevant cost data for decision making. Whether the decision is short or long range, the cost accounting system should be responsive to the information needs of the manager.

In order to meet the above objectives, a cost accounting system will normally contain certain features. These features can best be described through the use of a theoretical cost accounting model (TCAS) which is presented as Fig. 8. As each aspect of the TCAS model is developed, a comparison will be made with the UCA. This comparison will be made utilizing the model developed in the previous section which contains both the uniform chart of accounts and the financial accounting system. Like the model described in the previous section, the

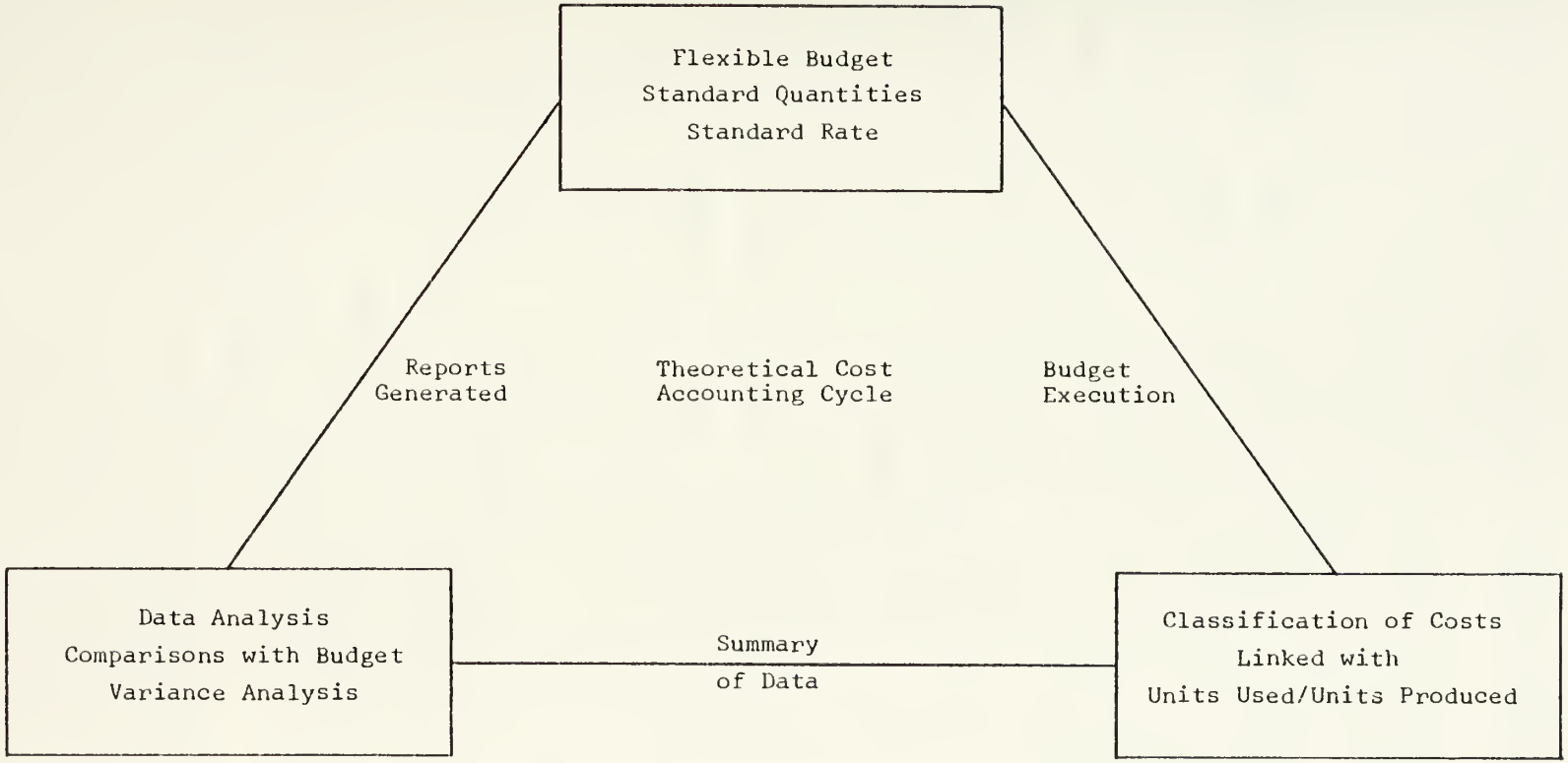


Figure 8

Relationship of UCA to Theoretical Cost Accounting System

theoretical cost accounting system begins with a budget which contains three important features.

First, since the production level for the budget period is only an estimate, a flexible budget should be prepared which presents budget needs at several levels of output. Although this is not in agreement with the capitation budget philosophy, it does acknowledge that different levels of output have different funding requirements. It may be advantageous to use one method as a check on the other. Second, the quantity requirements for labor, material and overhead should be founded on standard quantities. For example, two units of material for each patient visit may be established as a general guideline. Usage rates which exceed this guideline could serve as a signal to the manager to look into the operation of the clinic. Finally, the cost of material, labor and overhead should be computed at a standard rate. For example, $4.25 per direct labor hour. The standard rate, like the standard quantity, could serve as a tool in investigating unfavorable cost variations. The capability of separating a cost variation into its quantity and price components aids in explaining the reasons underlying the variation.

At the present time budgets for naval medical facilities do not contain any of the features presented above. However, the uniform chart of accounts has the capacity to satisfy all three requirements. Standard costs and standard quantities may be based on the average cost per unit and the average

quantity required initially and later may be based on engineering estimates. Once the standard costs and quantities are available and basic facility information such as square feet for each area, staffing per area, number of pounds of linen consumed per patient, etc., are available, budget estimates for varying levels of production may be prepared.

The second element of the TCAS model is perhaps the heart of the system. In this element costs are classified and are linked to unit quantities of input and unit quantities of output. The most important part of the TCAS system is the classification of costs which should include the following as noted by Matz and Usry [26].

First, costs should be classified with respect to the accounting period in which they apply. If expenditures are made to benefit future periods, they should be classed as an asset. If made to benefit the current period, expenditures should be classified as an expense.

Second, costs should be classified as to their tendency to vary with volume. Briefly, costs should be identified as to fixed, variable or semi-variable depending upon how they react to changes in volume.

Third, costs should be classified in relation to the product. In other words, costs may be identified as direct labor, direct material or factory overhead.

Costs should be classified in relation to the role in production. This means that costs should be identified as belonging to either a "producing" department (directly involved in the production of health care for instance) or a "service" department (not directly engaged in health care production but renders a particular service for the benefit of other departments).

Fifth, costs should be classified for analytical processes for decision making to provide a basis for managers to determine the estimated costs of alternative courses of action.

Finally, costs should be classified as to the nature of the item. Is this a cost of producing the product (health care) or a cost of a related function (drug screening program)?

It is the opinion of this author that if the uniform chart of accounts is to achieve its full potential, it must include the above classifications. At the present time, the uniform chart of accounts does contain many of these classifications. One of the biggest weaknesses of the UCA is that it does not classify expenses as to fixed, variable or semi-variable. While a cost per unit is obtained with the uniform chart of accounts, comparisons between different departments or activities may not be meaningful. Matz states, "Unless a cost system pays due regard to this distinction (identifying fixed, variable and semi-variable expenses) costs accumulated and reported for planning the company's strategy or for costing individual products or services will not be of material value to management." [26]

Another classification not made by the UCA is that for budget preparation and computation of standard costs. Use of the UCA with standard costs could do much to remove a perceived appearance of subjectiveness from the distribution of resources by higher authority.

Another weakness of the UCA is that while the accounts are presumed to collect material and direct labor only, the expenses are not specifically tracked or identified as such in the accounts.

Finally, the uniform chart of accounts does not yet classify costs of analytical processes. Although the UCA does not perform these classifications at the present time, it contains the framework which would enable it to do so. It seems likely that the UCA will be eventually expanded to include additional classifications.

The linkage is also an important part of the TCAS. The linkage associates output quantities with the resource cost which is necessary if cost per unit (input or output) is to be computed and in order for analysis of variances to be undertaken. The linkage may be demonstrated by the use of simple "T" accounts. Suppose there is a medical clinic which sees ten patients. In order to operate the clinic, one doctor, one nurse and 20 units of material are required. The clinic is assigned overhead at a standard rate per direct labor hour (DLH). The doctor earns $50 per day, and nurse $25 per day. Supplies cost $0.50 each and the standard overhead rate is

$0.50 per DLH. The linkage between cost and quantities is portrayed below. Through this simple example it can be seen that the linkage ties the cost in dollars incurred to quantities used or produced. The UCA does associate quantities of output with the total expense incurred during the period. However, quantities of inputs are not assigned to the expense for input. This will make variance analysis a problem since it will be difficult, if not impossible, to determine if there is a materials variance, a labor variance or an overhead variance.

	QTY	COST	QTY	COST
Labor	1 Doctor	$50	10 patients	$93
	1 Nurse	25		
Material	20 Units	10		
Overhead	16 DLH	8		
TOTAL:		$93		

Cost per patient visit = $93/10 = $9.30

The third element of the TCAS is the analysis of the data in order to assist managers in the day-to-day operations, comparison with the budget to determine compliance with the financial plan, and analysis of significant deviations from the financial plan. General analysis of the data to assist managers may take any form and is usually at the discretion of

the manager. Comparison with the budget is usually a mechanical procedure, hence will not be further discussed. Analysis for deviations from the financial plan, or variance analysis, perhaps has the greatest potential benefit. Briefly, the total variance is analyzed to determine if the reason for the variance is due to materials, labor or overhead. Material and labor variances are analyzed to determine if the variance is due to a deviation in quantity or a deviation in price while overhead variances may involve several analyses. In this manner, management can take corrective action where warranted. While the UCA will enable managers to determine that a variance has occurred, as indicated by a deviation in total cost and cost per unit of output, managers will be hard pressed to determine where the variance occurred -- materials, labor or overhead. Again the UCA offers the framework to facilitate variance analysis should higher authority be so inclined.

At the beginning of this section, five uses for data to which a cost accounting system should respond were presented. They were:

1. To facilitate budget preparation.
2. Encourage cost control through responsibility accounting.
3. Enable comparison of expenses with revenues.
4. Assist in the establishment of selling prices.
5. Furnish data for decision making.

The Uniform Chart of Accounts for Military Medical Treatment Facilities has the potential to fulfill all of the above requirements. It is this author's opinion that this could best be achieved by utilizing the uniform chart of accounts as a cost accounting system. As the analysis has shown, the UCA already contains many of the features of a cost accounting system.

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